University of Michigan

Engineering News

Tribune Building, New York City.

GEO. H. FROST, Proprietor.

SATURDAY, AUG. 6, 1881.

At a meeting of the manufacturers of cement held at the Mechanics' and Traders' Exchange, Aug. 4, 1881, Warren A. Kerman, Chairman, and Hiram Snyder, Secretary, it was resolved that all the manufacturers reduce the production of their respective works sufficiently to maintain the prices fixed, as per agreement made in April last.

The semi-centennial exhibition of the American Institute will open Sept. 14. Those who intend exhibiting and who have not already applied for space should do so without delay. Machinery will be received as early as Aug. 22; other goods Sept. 5. To facilitate the management exhibits should be in position promptly by the opening day.

PERSONAL.

According to a letter from Capt. T. P. Roberts, a Brazilian law is to the effect that the remains of any one dying of the fever cannot be removed from the country for a period of three years. Should such be the case, it follows that the remains of the late Colonel Roberts cannot be laid among those of his relatives in his native State until this time shall have elapsed.

The death at sea of Henri Bionne, Secretary General of the Panama Canal Company, is announced. He was on his way from Aspinwall to New York on board the Pacific Mail steamship Crescent City. M. Bionne was born of a distinguished family and early in life entered the French navy, in which, in course of time, he rose to the rank of a commander. Leaving the sea he devoted himself to the study and practice of civil engineering. He soon became celebrated for his skill, and the Count de Lesseps engaged him as his assistant in his herculean project of the Suez Canal. M. Bionne ardently entered into the spirit of the work and rendered his chief devoted and efficient aid in the difficulties which were to be overcome. The labor he accomplished was unceasing, and with but few intermissions he remained on the scene of the undertaking from its inception to its completion. Returning to Paris in triumph with his veteran chief, whose confidence he fully enjoyed and merited, he was created an officer of the Legion of Honor, and as a substantial reward for his arduous services he was made general secretary of the Suez Canal Company. When the scheme of constructing the Panama Canal was devised M. Bionne was fully impressed with its practicability. In public speeches and in letters to the press he frequently felt himself constrained to reply to hostile or unfavorable criticism, and producing a startling array of scientific facts he often demonstrated the feasibility of the undertaking and the comparative ease with which it could be accomplished. His experience with the Suez Canal had taught him that undaunted perseverance and a thorough knowledge of engineering were sufficient to overcome the most serious obstacles. Desiring to visit the country and explore for himself the route of the proposed canal he accompanied M. de Lesseps in his tour to this country and took part in the organization of the company and the details of the scheme. Shortly before actual work began he returned to Paris and busied himself in work connected with the fiscal management of the company. His influence as a recognized authority on canal construction being very great in France he naturally was of immense service in guiding public opinion and preparing financial circles for the favorable reception of the shares when thrown on the market. After very happy results in this direction he returned to Panama, with instructions from the committee in Paris to thoroughly inspect the progress of the work, and to report exhaustively to them upon it. On July 8, shortly before his departure for this city, an entertainment was given in his honor, at which nearly all of those interested in the canal were present. By his death M. de Lesseps loses his most efficient assistant, and the canal project suffers a severe blow.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 305.)

LI.—CHARLESTON.

Charleston, South Carolina, in Lat. 32° 45' N, Long. 79° 57' W, is situated upon a tongue of land between the Ashley and Cooper rivers. There was a considerable settlement there as early as 1680, known as Charles Town. In 1783 it was incorporated under its present name of Charleston. It is about three miles long and two miles wide at the widest points, and half a mile at the narrowest. The area is 5.16 square miles.

The streets are somewhat irregular, having been laid out in its early settlement to conform to the high land, as tide water creeks and ponds and marshy spots covered a great portion of what is now the thickly settled part of the city; which lies from 8 to 12 ft. above high water mark.

Since 1824 five different attempts have been made to obtain good water by means of artesian wells.

In 1848 Major Welton began boring a well at the corner of Wentworth and Meeting streets. Quicksand gave much trouble, sometimes filling the tubing 150 ft. in one night. In 1861 work was discontinued at a depth of 1,250 ft., tubed with 6-in. pipe at top and 3 in. at bottom. The well discharged 25,000 gallons a day of water of a temperature of 88° F., strongly impregnated with sodium and magnesium. It now supplies a few bath-rooms and the rest runs to waste in the street.

In 1876, F. Spangler began boring a well at the corner of Citadel and Green streets, which has 5-in. tubing at top, 2¾-in. at bottom, 1,970 ft. deep, and from which pure soft water of 99° F. rose 90 ft. above the surface. Its yield is 200,000 gals. per day. The well cost $25,000 and was a little more than a year in sinking.

In February, 1879, the City Council made a contract with parties to build a reservoir and standpipe, lay water pipe and bore other wells. The contractors not carrying out their agreement, the contract was annuled, and in January, 1881, another made with a company. This company has employed Mr. Spangler to bore another well 2,000 ft. deep and 10 to 6 in. bore for $30,000. The work is now in progress.

Fifteen miles of cast-iron distribution pipe have been laid, of from 16 to 6-in. diameter, and a small quantity of 4-in. diameter.

The water from the present well flows a quarter of a mile through a 4-in. pipe, discharging into the reservoir at an elevation of about 6 ft. above the surface.

The reservoir has a capacity of 3,300,000 gallons. It is excavated to a depth of 12 ft., with embankment 8 ft. high. The bottom is a shell formation, upon which a layer of 12 in. of puddled clay is laid, then brick laid in gravel and filled in with cement. The walls have a layer of puddle 2 ft. thick, then two bricks laid edgewise in cement. The east wall has sunk several inches, leaving a crack at each angle, which has been filled up with cement. No leak is apparent however from this settling and crack.

The stand-pipe is 90 ft. high by 18 ft. in diameter, and is supplied through a 20-in. pipe by two Knowles pumps of 20-in. diameter and 36-in. stroke, each capable of a pumping capacity of 4,000,000 gallons daily.

The supply from the present well is only a little over 200,000 gallons daily, and is inadequate to the demand. A reserve of about 2,000,000 gallons is kept always in the reservoir in case of fires, and the entire daily flow of the well is pumped into the stand-pipe for distribution.

The present company found a bonded debt upon the works of $250,000. The bonds now outstanding are $200,000 5 per cent. first-mortgage; $100,000 6 per cent. second-mortgage, and $100,000 6 per cent. income. The amount received from the city ($10,000) for fire hydrants and supply of public buildings is sufficient to pay the interest on the first-mortgage bonds. The works have only been in operation one year, and no printed reports of receipts and expenditures have been made, but the income from private consumers is now sufficient to pay the ordinary running expenses, leaving city and state taxes (about $3,000), and the interest on the second-mortgage and income bonds to be otherwise provided for.

Col. Zimmerman Davis is the secretary and treasurer of the company.

LII.—TERRE HAUTE.

Terre Haute, Indiana, is on the east bank of the Wabash River, on a high, level plateau, about 50 ft. above low water, in lat. , long.

Settled in 1816, it was incorporated as above in 1832.

The Terre Haute Water-Works Company was organized in 1871. The works were completed and accepted by the Company Oct. 1, 1873. The water is taken from the Wabash River at a point above all city pollution. The pumping-house is on the bank of the river.

The water flows through a filter-bed, filled with gravel, into two receiving wells 12×12×8 ft. Thence by the suction pipes 24 ft. to the pumps, which have a lift at low water of 5 ft. The annual rise of the river is from 20 to 27 ft. above low water, and the filter is submerged a greater portion of the year, and has not proved successful in furnishing clear water. The water at its high stages has a light coloring matter held in suspension, which can only be removed by precipitation. The water with this exception is good and is very soft. The pumping machinery built by Clapp & Sons, of Hudson, N. Y., consists of two sets of condensing beam engines. Each set has two steam cylinders of 20-in. diameter and 36-in. stroke, with a pump of 9-in. diameter and 36-in. stroke to each cylinder. Water is pumped directly into the mains. On the main leading from each pump is an air chamber of 26-in. diameter and 30 ft. high, with an air pump for regulating the density of the contained air.

The engines are furnished with an adjustable cut-off designed by J. H Briggs, which has been in successful use 3 years.

Each set of pumps throws 38⅛ gals. of water per revolution, making their capacity at an easy service of 27 revolutions 1,500,000 gallons in 24 hours. In case of fire their speed is doubled.

Distribution is by cast-iron pipes of from 16-in. to 4-in. diameter, of which 19.5 miles are in use, and 376 fire hydrants.

Lead service pipes are used, as iron corrodes rapidly in the prairie soil on which the town is built.

The cost of the works has been $301,169.35. The consumption of water is about 920,000 gallons per day. J. G. Briggs has been superintendent of the works from their beginning. The number of con-

* Copyright 1881.

sumers and the annual expenditures and revenue are not furnished.

LIII.—TAUNTON.

Taunton, Massachusetts, is on the Taunton River, 23 miles south of Boston. It was incorporated as a town in 1639 and as a city in 1864.

Water-works were built by the city in 1876–7, after the plans and under the superintendence of George H. Bishop, C. E.

Water is taken from a filter gallery or basin, 100 ft. from the shore of the Taunton River, at Shallow Water, and pumped directly into the mains. The filter basin is 400 ft. long with slopes of 2 to 1. Its bottom is 17 ft. wide at 8 ft. below mean low water mark. The slopes are paved with stone for 18 ft. from the bottom and sodded above. The ground rises back of the basin, and the ground water rises 14 ft. in 1,000 ft., after which the slope is flatter.

In 1877 a daily draft of 250,000 gallons, lowered the ground water near by about 2 ft., and a draft of 600,000 gallons per day for 5 days affected the surface of the ground water 80 ft. from the basin.

A 36-in. wrought-iron pipe laid 4 ft. below the bottom of the filter bed conducts the water to the pump well 28 ft. deep. The well is also connected with the river by a 30-in. wrought-iron pipe ending in a plank crib 20 by 18 ft., inside of which is a second crib 12 by 10 ft. The space between these two cribs is filled with broken stone, with a 2-in. opening between each plank of the crib.

The water is pumped directly into the mains by a Holly compound engine with four steam cylinders of 14-in. diameter, operating four pumps of 9¾-in. diameter, all of 24-in. stroke.

For fire pressure a horizontal high-pressure engine drives two rotary Holly pumps.

The distribution is by cast-iron pipe, 27.5 miles of which, with 239 fire hydrants and 182 meters, were in use January, 1880. In January, 1878, there were 651 taps. Most of the service pipe is of wrought iron lined with cement. The consumption in 1879 was 394,061 gallons per day. The population in 1880 was 21,213.

The cost to Jan. 1, 1880, was $276,876.18.

The works are managed by a board of three commissioners. George H. Bishop was chief engineer to 1878.

LIV.—NEWTON.

Newton, Massachusetts.—In 1875 works were built by the city, after the plans and under the superintendence of Edward Sawyer, C. E.

Water is taken by a natural open filter basin on the bank of the Charles River, on the other side of the river from Newton in Needham, no suitable filtering material being found on the Newton side.

The basin follows the river in the shape of a bow. As first built, it was 975 ft. long, and in 1877 its length was increased 600 ft. The bank at this point is composed of large free gravel, which passes the water freely. The basin is from 70 to 88 ft. in width. Embankments were built along its sides for protection. The outer embankment is 10 ft. wide on top, about 10 ft. high above the natural surface, with inside slope of 2½ to 1 and outside slope of 2 to 1, paved on the outside with a stone paving about 2 ft. thick.

In 1880, under advice from William E. Worthen, C. E., a test pipe 2 in. in diameter was driven through the strata of fine sand on the bottom of the basin, 35 ft., to coarse gravel. The water rose in the pipe above the level of the water in the basin. Four 2-in., six 1½-in., three 1¼-in. and one 4 in. wrought-iron pipes were then driven, which are estimated to yield from 4 to 5 hundred thousand gallons in 24 hours.

A 24-in. outlet pipe crosses the river and conducts the water to the pumping station. As first built it extended to within 56 ft. of the engine house, and for the remaining distance a stone masonry culvert, 3 × 3.5 ft. was laid.

In 1880, under the direction of William E. Worthen, C. E., a 24-in. cast-iron pipe was laid in this conduit from the pipe chamber to the pump well, and the conduit filled with concrete to stop the flow of all ground water and quicksand into the well. As the use of a pump at the lower end caused a large inflow of quicksand, 8 1½-in. pipes were driven 35 ft. deep, spaced 15 ft. apart each way. Pumping from these driven wells removed the water from the trench, and the work was completed without difficulty. The interior of the conduit is accessible through two chambers, one in the bank at the basin and one 56 ft. from the engine house.

The pump well is 9.83 × 29.75 ft. and 15 ft. deep. The bottom of the well is a platform of Georgia pine, and the walls are of brick masonry.

The pumping machinery consists of one duplex high-pressure Worthington engine of 1,000,000 gallons capacity, with water plungers of 12-in. diameter and 15-in. stroke, and one Worthington compound duplex engine, with water plungers of 22-in. diameter and 50-in. stroke, of 5,000,000 gallons capacity.

The water is pumped into a pentagonal reservoir, in two divisions, built in excavation and embankment on Waban Hill, containing 15,000,000 gallons, with its water surface 265 ft. above low tide. A puddle wall is built in the bank, and a puddle lining 2 ft. thick extends under the bank, down the slopes and over the bottom. The slopes are covered with 6 in. of small stone, on which is a 15-in. pavement of stone.

Distribution is by cast-iron pipe, of which there were laid on Dec. 31, 1880, 60.3 miles, 6 miles of which is less than 6 in. in diameter. There were at that date 324 fire hydrants, 1,937 taps and 467 meters in use.

The population in 1880 was 16,995 and the daily consumption 468,476 gallons.

The total cost of construction to Dec. 31, 1880, exclusive of interest, was $854,937.73. The cost of maintenance since 1876 has has been $38,577.59 and the receipts $117,250.64.

In 1880 the expenditures were $9,758.70 and the revenue $33,734.58.

The works are managed by a committee of the Common Council, H. Nelson Hyde, Jr., being the superintendent, and since 1878 Albert F. Noyes, the city engineer, acting as engineer of the water-works.

LV.—ALEXANDRIA.

Alexandria, Virginia, is on the south bank of the Potomac River, 6 miles below Washington City. The ground rises from the river to an elevation of about 50 ft.

Founded about 1780 its population in 1851 was 9,000, when water-works were built by a private company after the plans of Frederick Erdman, C.E. Water is taken from Cameron's Run. A mill site was purchased, and a new iron 20-ft. wheel put in, driving a double acting 10-in. pump with 120-in. stroke, which forced the water through a cast-iron pipe into a reservoir 200 ft. square and 16 ft. deep, 96 ft. above tide, in two divisions. A 10-in. main led to the city; seven miles of pipe were laid. In December, 1852, these works had cost $88,000, and there were 180 takers, and in the following year 400 takers.

In 1855 a steam pump was erected. The dam was considered unsafe in 1857, and an old raceway leading from a point further up the stream was cleared out and put in use just before a freshet swept away the dam. A small dam above then enabled the company to obtain all necessary water. In this year the steam engine was used only thirty-eight hours. The military occupation of the city from 1861 to 1865 created so great a demand for water that much muddy water was pumped and the reservoir had to be cleared in 1866. The dam was washed away during the war, and a slide occurred in the reservoir bank. The dam and reservoir were again seriously damaged by storms in 1867. A new reservoir was built in 1874, after the plans of Washington Blythe, C. E. It is in excavation and embankment, is 300 by 500 ft. and 17.5 ft. deep. In 1879 slight leaks in it were reported.

The pipeage, consumption, hydrants and taps are not given in the reports.

From 1851 to Jan. 1, 1859, the expenditures were $125,399.45, and the receipts $46,162.19. During the war the accounts were kept irregularly, and since then comprehensive statements do not appear. In 1879 the receipts were $14,630.63, and expenses $4,241.07.

Daniel W. Lewis was superintendent from 1851 to 1866, and Francis J. Power from 1867 to 1881.

LVI.—KALAMAZOO.

Kalamazoo, Michigan, in lat. ——, N., long. —— W., is situated in a valley 150 miles long and 100 miles wide, filled from 500 to 700 ft. in depth with glacial drift, saturated with water and underlaid with rock.

The first water supply was furnished by the Michigan Central Railroad Company, being the overflow from their tank at the depot. It was brought from Arcadia Creek in wooden logs. The overflow was conducted to a cistern in the court-house yard. It was used for fire purposes.

In 1860 George Bolles contracted to pump water for fire supply from his dam on the Arcadia; subsequently the dam was removed and the pumping done from Lawrence & Gale's factory.

In 1869 water-works were built by the city, taking their supply from a well sunk to 7 ft. below Astell's brook. This water proving impure, a brick well 24 ft. in diameter, the wall resting on a cast-iron shoe, with a cutting edge, was sunk by dredging from the interior through 14 ft. of fine sand into a porous gravel. The water then stood 24 ft. deep in the well. It is pumped directly into the mains by a Holly engine with two piston pumps, of nominal capacity of one million gallons, and two rotary pumps of like capacity. In 1873 two piston pumps were added. In 1877 the rotary pumps were replaced by a Worthington high-pressure duplex engine, of two million gallons capacity. Wood is used as fuel in the furnaces.

The distribution is by cast-iron pipe. In April, 1881, there were 15.9 miles of pipe in use, 12 miles of which are of less that 6-in. diameter; 147 fire hydrants are in use and 573 taps.

The population in 1880 was 11,937, and the daily average consumption 803,468 gallons.

The cost to 1881 has been $168,673.53, the total expenses of maintenance $87,229.12, and the total water rents $40,034.65.

The receipts for the year ending March 31, 1881, were $5,194.52, and the cost of maintenance $6,857.71.

The works are managed by a committee or fire and water. Until 1874 they were under control of the chief of the fire department. Since that time George H. Chandler has been the chief engineer.

LVII.—NEW LONDON.

New London, Connecticut, is situated at the mouth of the Thames River, on one of the best harbors in the United States. Founded in 1646, it was incorporated a city in 1784. In 1802 the city was partially supplied by the Aqueduct Co., the water being conveyed through logs from a spring near the northern part of the city. About 1840 the lower streets and wharfs were supplied through cast-iron pipe from a mill pond in the northern part of the city, and also from a well near the Wilson Manufacturing Co.'s works, in the centre of the city, the last named supply being pumped with power furnished by the Wilson Manufacturing Co.

In 1860, the 4-in. pipe from the mill pond having become obstructed with rust, it was replaced

with a 6-in. wrought-iron and cement pipe, which is yet in good order. The 3-in. cast-iron pipe from the Wilson Works is now used by the city works, and sustains a head of 140 ft.

In May, 1871, the legislature passed "an act to supply the city with pure and wholesome water," which was ratified by the citizens in September, 1871, and a board of water commissioners appointed.

The works were constructed in 1872, at which time the population was about 9,600; in 1880 it was 10,529.

Lake Konomoc, from which the supply is drawn, is about 6 miles from the city. It lies between high wooded hills, has a drainage area of 976 acres, and is 180 ft. above tide water. The original lake, which had an area of 110 acres, was raised 10 ft. by a dam built about 700 ft. below the outlet, increasing the area to 235 acres and capacity to 600,000,000 gallons. The city is supplied by gravity directly from this lake without intervening reservoir.

The site for the dam (which was very unfavorable, though the best that could be selected) was between two sand hills, the muck in the intervening valley being underlaid with a thin stratum of hard pan, which was in turn underlaid with quicksand from 4 to 15 ft. deep. The hard pan was left undisturbed and covered with a layer of concrete, on which a cement masonry wall was built through the entire length of the dam, and running into the banks on each side and to a height of one foot above high-water mark. As an additional precaution, a row of sheet piling was driven near the upper edge of the dam, and the whole filling in front of the masonry wall puddled and paved. The overfall (25 ft. wide) is in the centre, and built of granite laid in cement. The front is protected with a timber apron. No leak has ever been discovered through or under the dam. Water is drawn from a granite gate-house built on the dam through a 24-in. cast-iron pipe, a 16-in. running outside the gate-house for use when making repairs. The gate-house is arranged with screens and gates for drawing water from different heights.

The first 6,800 ft. of supply main is of Scotch clay pipe, with cement sleeve joints, and is under a head of from 18 to 20 ft.; the remainder of the supply and distribution mains are of wrought-iron and cement pipes, in sizes from 16 in. to 4 in. The length of mains in September, 1880, was over 21 miles, of which 6.5 miles is 4 in. and 6 miles 6 in. In the year ending September, 1880, there was 50 leaks, caused principally by a slight leakage in the lap, which oxidized the iron until it gave away. The present practice of coating the shells with asphalt before lining with cement has overcome this difficulty in pipe laid during the last three years. The service pipe, which was originally of rubber-coated wrought iron, is being replaced with cement-lined.

The number of service pipes in use is 1,285. The annual receipts are $16,647.32, no charge being made for fire hydrants or other public uses. The cost of maintenance is about $3,000 per year, and the total cost of the works is $291,840.

Meters have been used since 1873; there are now 25 in use.

The works are under the direction of a Board of Water Commissioners, of which William H. Barns has been president since the beginning of the work.

The works were designed by J. T. Fanning, C.E., who was retained as consulting engineer, W. H. Richards being the engineer in charge during the construction of the work, and the superintendent since that time.

LVIII.—POUGHKEEPSIE.

Poughkeepsie, New York, is on the east bank of the Hudson River, 75 miles above New York City. The ground rises rapidly from the river to a plateau 150 to 200 ft. high, and at College Hill rising to an elevation of 500 ft.

Settled in 1690, and incorporated as a city in 1854, its population in 1870 was 20,080, when water-works were built by the city after the plans and under the superintendence of J. B. G. Kand, C. E., James P. Kirkwood being the consulting engineer.

Water is taken from the Hudson River just above the city. A wharf, built on piles at the outer end in 24-ft. water, and of crib-work filled with stones near the shore, extended 80 ft. into the river. A box conduit 1 ft. high and 4 ft. wide conducted the water from 4 ft. below low-tide level to the lower pump well.

In 1877 a new inlet was made of 107 ft. of 24-in. cast-iron pipe in a box filled around with concrete and lowered into place at one operation. Its weight was 35 tons.

In 1880 the wharf was rebuilt.

From the lower pump well the water is lifted 20 ft. by a Worthington pump into a settling basin 25 × 60 ft. and 12 ft. deep, in three compartments arranged to deposit the heavier particles held in suspension in the water. From this basin it passes on two filter beds, each 200 × 73½ ft. and 12 ft. deep, with 6 ft. of filtering material arranged as follows: 24 in. sand, 6 in. of ¼-in. gravel, 6 in. of ½-in. gravel, 6 in. of 1-in. gravel, 6 in. of 2-in. broken stone and 24 in. of 4 to 8-in. broken stone, resting on a concrete floor, on which are open stone culverts which convey the water to an intermediate basin 6×85 ft. and 16 ft. deep, from which it passes to a reservoir 28×88 ft. and 17 ft. deep. From this reservoir it passes by 408 ft. of 18-in. pipe to the pump well. The filter beds cost $54,000. The cost of cleaning, washing and renewing the sand was, for each million gallons filtered, $3.50 in 1876, $1.51 in 1877, $2.40 in 1878, $2.75 in 1879 and $2.59 in 1880. The washing of the sand costs from 65 to 122 cents per ton.

In 1878 leakage from the filter beds caused anxiety, but it is not alluded to in later reports.

The rate of filtration per hour was, in 1876, 10.8 in.; in 1887, 10.2 in.; in 1878, 10.4 in., and in 1879, 6.9 in. The average quantity filtered per day has been 1,500,000 gallons.

From the pump well, the filtered water is lifted, by a Worthington pump, 264 ft. through 7,700 ft. of 18-in. cast-iron pipe to the distributing reservoir on the north slope of College Hill, 540 × 310 ft., and 11.5 ft. deep, holding 12,000,000 gallons. It is in excavation and embankment, with puddle wall in the centre of the banks, and puddled bottom, covered with 3 in. of coarse gravel. It has not leaked.

Distribution is by cast-iron iron pipes, of which 16.2 miles were laid in 1874 and only 1,000 ft. have since been added. There are 286 fire hydrants, 1,326 taps and 122 meters. The population in 1880 was 20,207, and the daily consumption 1,403,292 gallons. This is 216,000 gallons per day less than in 1876, notwithstanding an increase of 236 in the number of taps. The reduction is ascribed to the increased use of meters.

The works cost to Dec. 31, 1874, $602,545.09. The receipts for the six years since 1874 have exceeded the expenses for maintenance by $8,624.25. In 1880 the receipts were $19,379.34 and the expenditures $18,626.85.

The works are managed by a board of six water commissioners. Theodore W. Davis, C. E., was resident engineer of their construction, and superintendent to November, 1880. Charles E. Fowler, C. E., is the present superintendent.

CORRECTIONS.—Readers will please make the following corrections:

July 9. *Worcester*, p. 273, 8th paragraph, for *Coe's* read *Coes'*.

Ninth paragraph, for 16 *miles* read 76 *miles*. Full reports to date having been received since the article was written, insert after 9th paragraph:

On Nov. 30, 1880, there were in use 79.94 miles of pipe, 633 fire hydrants, 5,200 taps and 3,791 meters.

The expenditures and revenue for the 9 years from 1872 to 1880 have been as follows:

	Cost of construction.	Cost of maintenance.	Interest.	Revenue from water.
1872	242,065.78	14,528.27	35,593.02	58,410.03
1873	111,526.93	23,327.96	44,583.35	93,291.13
1874	106,502.85	16,367.71	40,619.60	95,532.52
1875	51,233.09	26,320.98	33,541.00	101,713.03
1876	150,217.89	15,815.91	25,513.00	98,585.14
1877	41,381.25	24,104.17	23,349.00	88,965.17
1878	35,275.02	13,765.26	24,639.00	73,073.17
1879	23,354.00	11,060.91	22,550.00	74,149.40
1880	30,625.35	15,124.37	22,124.00	84,325.80

A report on sources for additional supply was made by the City Engineer on June 25, 1881.

At end of tenth paragraph, read:

The city engineers have been Phineas Ball, 1864 to 1873; C. H. M. Blake, 1874 to 1878; Percy Daniels 1878, and C. A. Allen, 1879–81.

Frank E. Hall has been Water Commissioner since 1872.

July 16. *Troy*, p. 285, 2d column, 48th line, for 429 *miles*, read 42.9 *miles*.

July 23. *Hartford*, p. 293, 2d column, 1st line, for *J. W. McAlpine*, read *William J. McAlpine, C. E.*

30th line, for *dyke pond*, read *a pond*.

40th line, for *Coldwell*, read *Caldwell*.

42d line, for *east*, read *earth*.

Lynn, p. 293, 3d column in 5th paragraph of Lynn, read 16 *ft. high*.

P. 294, 1st column, 34th line, for *walls* read *wells*.

Hudson, p. 295, 10th line, for *screw* read *screen*

July 30. *Toledo*, p. 305, 7th line, for *Carl Schonn* read *Carl Schon*.

P. 305, 3d column, in the acknowledgments, for *Pere Haute* read *Terre Haute*.

[TO BE CONTINUED.]

Received from Col. Zimmerman Davis, Secretary and Treasurer Charleston W. W. Co., history of Charleston, S. C., Water-Works; from W. H. Richards, Superintendent New London Water-Works, reports of New London Water Commissioners, 1874 to 1880. Also history and description of New London Water-Works.

NEW YORK AND BROOKLYN BRIDGE.

(*Continued from page* 302).

From a paper read by Mr. Francis Collingwood before the American Society of Civil Engineers, June 17, 1879, we make the following extracts in regard to the

APPROACHES.

"The work on the designs for the approaches to the East River Bridge was begun about Jan. 1, 1877. The Brooklyn approach has a length of 900 ft. on the centre line, and starts from the street grade at Sands street, rising 2.85 ft. per 100 to the rear of the Brooklyn anchorage, where it has a height of about 60 ft. above ground. It is crossed by several streets at high angles, and has one curve at about 200 ft. from Sands street. The width throughout is to be 100 feet.

"The New York approach is 1,546 ft. long, rising from grade at Chatham street, 3.25 ft. per 100 ft. to the rear of the New York anchorage, where it is 68 ft. above ground. It will be 100 ft. wide for about 500 ft. from the entrance, and 85 ft. for the remaining distance. In Brooklyn all the streets will be crossed by box or plate girders. In New York, Pearl and Cherry streets, together giving an opening 210 ft. on one side and 170 ft. on the other, will be crossed by trussed girders; Cliff and Vandewater streets by semi-circular stone arches 51 ft. 8 in. span; Rose street by a three-centered

stone arch, 57 ft. span, and William and North William streets by box girders.*

"The architectural problem presented was one of considerable difficulty, owing to the requirements in the case. These were that the spaces underneath should be made available for storage or mercantile uses, thus enforcing the necessity of keeping the arches wide enough for this purpose; and requiring, in addition to this, that the structure should be imposing and harmonious in effect.

"The design as adopted was a composite one, being based upon one proposed by the writer as to general features, but being modified by the commission of architects as to the style of the arches, and made somewhat more ornamental in detail.

"The fronts are entirely of granite. The main features are massive abutments at each side of each street, projecting at the base about 7 ft. from the spandrel line. These have an ornamental plinth. The shaft is finished in smooth pointed work with chamfered edges; and the whole is surmounted by facia, cornice, pedestal and cap. The heaviest cap stones are 17 ft. long, 5 ft. wide and 2 ft. thick. Between the abutment piers the spaces are divided, so as to give arches varying from 17 to 31 ft. span. The small piers between have slighly battered sides, and terminate in ornamental caps or imposts, from which the arches spring. The arches are of the Florentine style, being broadest at the key and narrowest at the spring, thus giving a pointed extrados. This style was adopted by the architects in order to fill up the spandrel space, and not leave so large an amount of dead wall. The keystones in the largest arches are 8 ft. high and weigh about 11 tons. The arches are finished in the same style as the shafts of abutments. The spandrel is of a darker granite, in regular courses, but, rock faced.

"The cornice over the arches has a dentil course below, surmounted by a heavy projecting coping course, all in six-cut work. (I should here mention that the plinths, caps and pedestals are also of six-cut work.)

"The cornice is surmounted by an ornamental granite parapet 4 ft. high.

"The regular thickness of the exterior walls is 3 ft. 9 in. The division walls and interior of the abutments are of brick. The foundations are carried down where the bottom is sound to 3 ft. 9 in. above tide, but where sound bottom is not reached at this depth they go down until it is reached. In one place this was 9 ft. below tide. It may be well to record here the finding of trunks of oak trees in the muck at this point, which have, no doubt, been buried for centuries. The wood was perfectly sound, and was sawed up into walking sticks. The spot had been built upon for probably 200 years.

"The foundations as far as finished were well spread, and, as far as practicable, in such a manner as to give a uniform pressure throughout, not exceeding 5 tons per square foot when fully loaded. They were built of concrete, rough stone and brick work. They were faced with brick always when coming next to a cellar space. When such facings were used tie-walls were always carried across, so as to bind the mass together.

"All the brick and stone work is set in cement mortar, and the limiting strain on brick in compression is fixed at 200 pounds per square inch. The floors are in this supposed to be loaded, including their own weight, with 450 pounds per square foot, and the roadway above with 100 pounds per square foot.

"These are the *limits*, but the actual sections are considerably beyond these figures, and it is not at all probable that the loads mentioned will ever come on the floors. * * *

"Before closing, it may be interesting to members to mention the methods pursued in setting the stone work. The first thing done in every case, as soon as the ground was cleared of buildings, was to carry forward two lines of railroad track running through the work and at a convenient distance either side of the center line. Next two lines of derricks were put up, and strongly guyed in such positions as to reach all parts of the pits for excavation, and high enough to set all stone to and including the lowest arch stones. Then, since the walls on the New York side were to reach 68 ft. above ground, and the cap stones about 74 ft., it was deemed desirable not to attempt the use of the derricks further, but to use a traveling crane. The novelty of this consisted in the method adopted for turning the corners, as it had to set stones on three sides of a square.

The span of the trestle was 16 ft. At the inner angles corner posts were placed, carrying at their upper ends cast-iron turn-tables, the castings being in the form of a T, with the cross about 6 ft. long, and forming a portion of the track, and the vertical portion cast hollow and slightly conical, so as to turn freely on the post.

"The outer track was carried around with a curve of 16 ft. radius. When the crane had traveled forward so that the inner pair of wheels were balanced on the turn-table, a tripping piece threw them suddenly out of gear, and the outer wheels then traveled around the curve while the inner end of the machine pivoted on the turn-table. As the outer wheels reached the tangent again the inner ones were automatically thrown in gear, and the machine again traveled forward. Friction rollers supported the end of the turn-table arm as the weight passed off or on.

"The wheel base of the lower carriage was 3 ft. 8 in., and the only caution required was to see that the machine kept square with the track. Owing to the sharpness of the curve, there was considerable noise made in passing around it, but the machine did its work well. The design was elaborated and the machine built by Messrs. Schoner & Allen, of Tamaqua, Pa."

The following are extracts from the "Specifications for Saddles and Saddle-plates for the Brooklyn Tower, East River Bridge:"

"Each saddle will weigh about 25,000 pounds; two of the saddle-plates will weigh about 22,000 pounds each, and two about 19,000 pounds each; thus making a total weight of at least 91 tons.

SADDLES.

"The object of the saddles is to furnish a bearing with easy vertical curves upon which the main cables and a portion of the main stays may rest in passing over the pier. In plan, they are rectangular, 13 ft. by 4 ft. 1 in. over all; extreme height, 4 ft. 3 in., and the main portion 4 in. thick.

"Over the center of each, one of the cables passes through a groove 19.5 in. wide and 17.25 in. deep at its middle section.

"On each side of the main groove are two smaller grooves, in each of which four of the long stays are placed.

"The ends and edges of the grooves are all rounded wherever there is possibility of chafing of the wires.

"Seventeen openings are made underneath the grooves, to reduce weight and secure uniformity in thickness as far as possible.

"The longitudinal edges are carried 1 in. below the under surface of the saddle to make end bearings for iron rollers, upon which the whole will rest.

"The inner faces of these edges must be planed true; the under surface must also be planed true, very smooth, and so as to bear a straight-edge in any direction. For this purpose the contractor must make sufficient allowance in the pattern, as the dimensions given are to be those of the finished saddle.

"The outside of the two longitudinal edges must be true—that is, perfectly parallel and 'out of wind,' and free from roughness, but need not be planed.

"The grooves must also be free from roughness, but need not be finished.

SADDLE-PLATES.

"The saddle-plates are to rest in seats prepared in the masonry, and form perfectly true beds, upon which the rollers supporting the saddles may traverse.

"They are to be 16 ft. 2 in. long, 14¾ in. high over all, the outside ones 8 ft. wide at the center and 6 ft. 3 in. at the ends; and the inside ones 6 ft. 6 in. wide at the center. The same pattern answers for the inner ones by cutting a strip from one side. The central portion is to be 4½ in. thick, and the sides 3¼ in. thick, when finished.

"There are two lugs in each side channel to which stays will be attached.

"At the ends of the side channels, as well as the main channel, all the edges are to be rounded off to prevent chafing.

"The central channel is to have its surface planed perfectly true, very smooth, and so as to bear a straight-edge all over. The edges which form end bearings for the rollers are also to be planed true. The vertical sides of the main ribs on the face toward the rollers must be perfectly parallel, and must be planed true. Sufficient allowance must be made in the pattern for planing, in all cases.

"The edges of the central plates, where cut off, are to have a rough cut of say ¼ in. to insure their being true and parallel, but need not be planed smooth.

GENERAL SPECIFICATIONS.

"All angles are to be filleted, except those abutting the ends of the rollers.

"As soon as the castings can be removed from the sand, cleaned and dressed off, they are to receive a thorough coat of raw linseed oil. After this is hardened, a second coat of boiled linseed oil is to be applied.

"After the planing is completed, the planed surfaces are to be coated with tallow and white lead.

"The contractor is to make all patterns, do all the planing and finishing required, and deliver the finished castings either at the Brooklyn tower wharf, East River, or in the yard at base of the tower.

"The patterns are to be the property of the Bridge Company when the work is completed.

"The quality of the iron must be tough and strong. In order to test this, the contractor will be required to cast at least six sample bars from the same melting used in the plates. They must be 5 ft. long, 1 in. square, and when placed on supports 4 ft. 6 in. apart must break with no less than a central load of 500 pounds.

"Trial bars of the metal proposed to be used must also be furnished the engineer for experiment, before the plates are cast.

"The castings must be sound throughout, free from air bubbles, cold shuts, strains or cracks; and in order to insure freedom from strains, they must lie a sufficient time in the sand to insure slow cooling.

(TO BE CONTINUED.)

* This was afterward changed and stone arches substituted. That at William street is a stone arch of 38 ft. span and 6 ft. 5 in. rise, and that at North William street a stone arch of 40 ft. span and 5 ft. rise.

CORRESPONDENCE.

PROBLEM IN GEODESY.

FERRISBURG, Mich., July 29, 1881.

EDITOR ENGINEERING NEWS:

The solution of the "Problem in Geodesy," given in your issue of June 11, by Mr. Houston, is yet capable of improvement, if we are to regard *simplicity* of work in the field as having any merit.

In the manual of Messrs. Bluff and Berger page 48, is a table of the inclination of meridians for one mile of longitude, on each degree of latitude, from 10° to 60° computed by me; and on page 42 will be found the investigation of the formula by which the table was made.

Having this table, we have only to *divide the given deflection* (in this case 30″) *by half the inclination for the given latitude*, for the length of the chord in miles.

Thus, for latitude 39°, the inclination for one mile of longitude is 42″.17. Then 30″÷21″.085 = 1.4223 miles = 7,510 feet = the length of the required chord.

Some may prefer to determine points in the parallel, by means of offsets from a line that is at right angles to the meridian.

In this case, it is only necessary to multiply the inclinations for one mile, on the given latitude, by some convenient number of miles—say five—and then by the *sine* of the inclination thus found, when we shall have the offset for the assumed distance; thus, for five miles on lat. 39° the offset would be—

$$= \sin.\left(\frac{5 \times 42''.17}{2}\right) \times 5 \times 5280 \text{ ft.} = 13.50 \text{ ft.}$$

Having the offset for five miles, it is easy to find it for intermediate distances, by dividing the offset for the assumed distance by the square of the number, n, of the points described; thus, for half-mile distances, we should have:

$13.5 \div 10^2 = .135$ ft. for the offset for the first half-mile; and $n^2 .135$ ft. for the offset at station n.

H. C. PEARSONS.

PROBLEM IN GEODESY.

LAS VEGAS, N. M., July 20, 1881.

EDITOR ENGINEERING NEWS:

In your paper of June 11 the following inquiries were made by Mr. J. M. Houston, to which I have seen no replies to this date.

1. What is the best method of running an east and west line when a good degree of accuracy is required, as for instance, a state or county line, and the surveyor has no other instrument except a

first-class engineer's transit (that is, no astronomical instruments)?

2. If the above line is run at right angles to the meridian of the starting point, and posts set at distances of one mile, what will be the offsets at each mile in latitude 39° N., that is, what distance would each stake have to be set north at (1), (2) ——(10)?

In reply to the above I would say that the most accurate method is that suggested in the second inquiry, by means of a line at 90° to the meridian of the initial point, with offsets at each mile in the plane of the corresponding meridian. This method has been used by the U. S. engineers in determining important boundaries, the calculations being made by means of modifications of what are known as the L. M. Z. formulæ in use by the U. S. Geodetic and Coast Survey Department, and although of complicated derivation are very simple in application by the assistance of published tables which are given in Appendix 19, Report of 1875, and may be procured at the above office on application. The formulæ are as follows:

$$(1)\ dL = -\frac{D^2 \tan. L}{2\,NR \sin. 1''}$$

$$(2)\ dZ = -\frac{D \sin. Z \sin. l}{N' \cos. L' \sin. 1''}$$

in which L = latitude of the initial point; L' = ditto of any point desired on the line at 90° to meridian of initial point; D = dist. measured on above line; N = normal at L produced to minor axis. N' = ditto at L'; R = radius of curvature at L; dL = difference between L and L'; dZ = difference of azimuth of points on measured line at 90° to initial meridian.

$$l = \frac{L + L'}{2}$$

Z = azimuth at initial point = 90° or 270°. The value of $\log. \left(\frac{\tan. 39°}{2\,NR \sin. 1''}\right) = -C = 1.313086$ and $-dL = \log. D^2 + 1.313086$.

The value of $\log. \left(\frac{1}{N' \sin. 1''}\right) = A' = 8.509207$, and $-dZ = \log. \left(\frac{D \sin. Z \sin. l}{\cos. L'}\right) + 8.509207$. If desired, the difference of longitude = $d\,M$ may be found from (2) by omitting the factor $\sin. l$ in the numerator and changing the sign of the second member, making both members of the equation +.

The above values are in seconds of arc, and may be reduced to feet by multiplying by the value of 1″ in feet. 1″ of meridian at lat. 39° = 101.16 ft. Azimuth is measured according to custom from south to west, north and east, following the direction of the movement of clock hands. When the above-mentioned tables are not at hand, the necessary values of A and C may be found, with some labor, by the following values:

$$N = \frac{a}{(1 - e^2 \sin.^2 L)^{\frac{1}{2}}};$$

$$NR = \frac{a^2 (1 - e^2)}{(1 - e^2 \sin.^2 L)^{\frac{3}{2}}};$$

in which a = equatorial radius of earth = 6377397.16 meters, log. = 6.8046435; $e^2 = 0.006674372$, log. = 7.8244104; log. $(1 - e^2) = 9.9970917$; $\sin. 1'' = 4.6855749$. The resulting values are in meters. One meter = 3.28070878 feet; log. of feet = 0.5159677; log. of 1 mile expressed in meters = 3.2066665.

The value of 1″ of meridian arc may be found in feet by the following expression:

$$s = 101{,}435\ (0.99833 - 0.005\ cos.\ 2\ L).$$

The line at right angles to the initial meridian may be laid off very accurately with a good engineer's transit, reading to 30″ by repeating the angle, or rather by laying off the angle approximately, as close as a single setting of the limb will allow, and then measuring the angle of the line so set up by repeating several times the entire circle of the instrument and averaging the values so determined. A simple computation will determine the amount the point observed upon will require to be moved north or south to bring the line exactly at right angles to the meridian. It will be found necessary to compute only two or three offsets by the formula, as it will be observed that they vary, within practical limits, as the square of the distance from the initial point. Six figure logarithms will give results sufficiently accurate, unless the values of A and C have to be computed, when seven figures should be used in finding the values of N and NR.

The above method was used in determining the boundary line between the United States and Mexico, the distances measured from the initial meridian being in no case greater than 30 miles, when a new initial point was taken and a new line laid off.

The formulæ used were in a different form from the above, but identical in results.

Distance.	—dL	dL in feet	L′.
1 mile	0.0053″	0.536	38° 59′ 59″.995
2 miles	0.0213″	2.155	59.97
3 miles	0.0479″	4.846	59.95
4 miles	0.0852″	8.619	59.91
5 miles	0.1332″	13.470	59.87
6 miles	0.1917″	19.397	59.81
7 miles	0.2610″	26.402	59.74
8 miles	0.3409″	34.483	59.66
9 miles	0.4314″	43.640	59.57
10 miles	0.5326″	53.878	59.47

Distance	—dZ.	Z′ (Z=00°)	Z″ (Z=270°)
1 mile.	00° 00′ 42″.10	89° 59′ 17″.90	270° 00′ 42″.10
2 miles.	01 24″.19	58 35″.81	01 24.19
3 miles.	02 06″.29	57 53″.71	02 06.29
4 miles.	02 48″.38	57 11″.62	02 48.38
5 miles.	03 30″.48	56 29″.52	03 30.48
6 miles.	04 12″.58	55 47″.42	04 12.58
7 miles.	04 54″.67	55 05″.33	04 54 67
8 miles.	05 36″.77	54 23″.23	05 36.77
9 miles.	06 18″.86	53 41″.14	06 18 86
10 miles.	07 00″.96	52 59″.04	07 00.96

CALCULATION.

	Latitude 39° 00′ 00″ Z = 90° or 270°		
D	1 Mile.	5 Miles.	10 Miles.
log. D^2 in meters	6.413333	7.811273	8.413333
C	1.313086	1.313086	1.313086
—dL	7.726419	9.124359	9.726419
	0″.0053	0″.1332	0″.5326
log. D in meters	3.206666	3.905636	4.206666
" sin. Z	±0.000000	±0.000000	±0.000000
A	8.509207	8.509207	8.509207
" cos. L′ ar. comp.	0.109497	0.109497	0.109497
log. dM	±1.825370	±2.524340	±2.826370±
sin. 1	9.708872	9.708872	9.708872
—d Z	1.624242	2.323212	2.6242?2
	±42″.10	±210″.48	±420″.96

H. C. BALDWIN.

FORMULAS FOR TURNOUTS.

WHEELING, W. Va., July 30, 1881.

EDITOR ENGINEERING NEWS:

In Searles' Field Engineering he gives formulæ: Given, a main track, curved, and a frog angle F to locate a turnout on the inside of the curve; also, for a turnout on the outside of the curve. I would like to know the formulæ when the radius of the main track and radius of the turnout only are given to locate a turnout both on the inside and outside of curve. Mr. Searles has proposition: "Given, a compound curve ending in a tangent; to change the P. C. C. so that the curve may end in a given parallel tangent," which requires four (4) formulæ to solve the proposition. It is much simpler (and is it not equally correct?) to simply change the radius of the second branch ending in a parallel tangent by formulæ

$$R' = R \pm \frac{\text{dist. between parallel tangents}}{1 - \cos. I}$$

and start from the same P. C. C., the same as for a simple curve, when you start from the same P. C.

Very respectfully,

RESIDENT ENGINEER.

LETTER FROM W. MILNOR ROBERTS.

AMERICAN SOCIETY OF CIVIL ENGINEERS,
NEW YORK,
127 East Twenty-third street,
July 27, 1881.

George H. Frost, Esq., Editor Engineering News:

MY DEAR SIR: I send you a letter recently received from Col. Roberts. It is in substance the same as you printed from the *Rio News*, but as one of the later letters of the Colonel may be of particular interest. Truly yours,

JOHN BOGART.

RIO DE JANEIRO, June 14, 1881.

John Bogart, Esq., Secretary, etc.:

MY DEAR MR. BOGART: A mail steamer leaves to-morrow direct for New York, and I take advantage of it to write; chiefly to mention a change of the programme in my movements, called for by instructions just received from the government, which requires me to defer my partly arranged coast line trip down to Rio Grande do Sul, in order to make certain examinations in the interior of the Province of Minas Geraes—relating to the prolongation of the main trunk line—the old Dom Pedro Segunda railway, over to the head waters of the Sao Francisco River, and down the Das Velhas, the most easterly of the two great confluents which form the main Sao Francisco.

The Dom Pedro Segunda Railway, by its prolongation, is already in operation to Barbecena, miles from Rio de Janeiro, and the work of construction is going on northward on the prolongation. There are two objects in view in the present investigation; one to determine the most advantageous railway terminal point on the Das Velhas River, the other to ascertain the practicability of improving the navigation of that river. It is a question how far up the river should be improved; and how far down the railway should go.

I expect to leave here the latter part of this month (as soon as my reports upon the posts north of Rio are finished), to go by rail to Barbecena; thence on horseback five or six days to Sabara; thence in a barca, or a large canoe, down the Das Velhas, between four hundred and five hundred miles to its mouth, or junction with the main Sao Francisco, the point I reached in "ascending the Sao Francisco" from the sea in 1879.

Returning, I will probably travel on horseback or muleback over a mule road perhaps not over one-third the length of the exceedingly crooked river to Sabara. There are settlements at intervals on the way. Between Sabara and Barbecena I may have an opportunity of visiting the great gold mines of Brazil, which I have not yet seen. The region is regarded as very interesting geologically, not only in connection with gold mining and diamond mining, but agriculturally. I hope that the Commission will be accompanied by Prof. Orville A. Derby, who formed part of our Commission on the Sao Francisco River, though it is not yet officially arranged.

I have read various accounts and heard much concerning the region I am about to explore; but you know that seeing for one's self is the most satisfactory way of understanding a country. I have been in many parts of Brazil, but I am now to examine a field entirely new to me. It is said to be as healthy as any in the world, and, as all the other parts of Brazil have agreed perfectly with me, I hope for the same agreeable result during my coming trip.* My family will remain in Rio during my absence.

With kind regards to your family and our friends generally, I remain as ever,

Sincerely yours,
W. MILNOR ROBERTS.

MEXICAN ITEMS.

CITY OF MEXICO, Aug. 1.—The Government has granted a concession to Manuel Payro to construct a railroad from a point between Nantla and Tampico, touching at the City of Mexico, with a branch to Cuernavaca, and running to a convenient point between Chacahua and Marutea, Pacific Ocean. No subvention is to be paid. The work is to be commenced within two years and must be finished within ten.

The Attorney-General of Mexico has decided

* The Province of Minas Geraes is an empire in itself, averaging about 600 by 450 miles, or an area of 270,000 square miles. Its extreme length from southwest to northeast is about 900 miles.

Many years may elapse before this immense territory can be developed, but there can be no doubt that the true way to develop it is to build railways through it, and to improve its principal water courses, the São Francisco to the north and the Paranahyba and Grand to the south, flowing to the La Plata.

that Congress can annul railway grants if it finds that the President has exceeded the authority given him to act between the sessions.

REPORT OF THE COMMISSION OF EXPERTS ON THE CONDITION OF THE KANSAS CITY WATER-WORKS.

KANSAS CITY, April 16, 1881.

Hon. C. A. Chase, Mayor Kansas City; Hon. Joseph N. DuBois, Chairman Special Committee by Resolution No. 20,659 of Common Council, and Hon. John Donnelly, Chairman of Sub-Committee on Water-works Investigation:

GENTLEMEN: The undersigned, having been appointed commissioners to investigate the efficiency of the water-works supply as applied to the protection of the entire city under the present system, to improve the efficiency of said works and thereby secure to the city additional protection, have the honor to submit the following report:

At a meeting of the special committee of the Council called on March 26 a committee was appointed to prepare such questions in regard to the water supply of the city as in their judgment would most clearly present the important points requiring investigation.

This committee was composed of members of Council, the City Engineer, the Chief of the Fire Department, the Chief Engineer of the Water-Works Co., and several private citizens.

The questions submitted to us by this committee are:

1. *Question.*—Is the western part of the city, usually called "the bottom," supplied with water from a system of pipes distinct from the system supplying the balance of the city?

Answer.—The distribution main supplying water to "the bottom" is connected with the pumping mains where the latter cross Liberty street. At this point there are two valves so arranged that either the pressure due to the water in upper reservoir or that in the pumping main supplying upper town can be put upon the distribution pipe in "the bottom." When the water from upper reservoir is not required to give back pressure on any of the pumps, then the system of pipeage in "the bottom" may be considered entirely distinct from the distribution in upper town.

Whenever back pressure from upper reservoir is needed at the pumps, the two distributions are worked together.

2 *Question.*—Are the systems of distributing main pipes in "the bottom" and in the balance of the city so connected that in case of breakage in, or accident to, either system between the water-works building and any fire, water can be forced through the other system into the pipes of the disabled beyond the point of accident, to put out fire? If not, is it expedient or wise to make such connection or connections, and what is the best plan therefor?

Answer.—The distribution mains in "the bottom" are entirely separate from those in upper town except the connection with pumping mains as noted in answer to question No. 1.

In our judgment the liability of the water supply being cut off from any part of the city by bursting of the mains would be very much lessened if the two distributions were connected.

Our recommendation is that the pipe system be connected by laying a line of pipe of not less than 20-in. diameter from the pumping station along the foot of the bluff to Twelfth street; on Twelfth street west to Liberty street and east from Twelfth street and the bluff to and connect with the 15-in. main at Thirteenth and Jefferson streets, with valves placed on east and west lines at Twelfth street.

Ordinarily this line would furnish water to the distribution of lower town, but in case of accident to the pumping or supply main to upper town, water could be furnished to upper town by closing the west valve and opening the east one at Twelfth street.

A check-valve and by-pipe might be used on the east side of Twelfth street. In that case lower town could be disconnected and upper town connected by closing the valve on the west side.

Any accident occurring to the supply main on Liberty street in lower town, water could be furnished to lower town distribution through the 20-in. line along the foot of the bluffs.

3. *Question.*—Have the water-works been constructed substantially according to section 17 of the ordinance No. 10,524 and the contract with the city? particularly in the following respects:

(*a*) *Question.*—In the ordinary operations of the works is water distributed through the city by the Holly system, or from a reservoir at an elevation of at least 175 ft. above the city directrix?

Answer.—To assist in fully understanding the answer to this question and its sub-divisions, it is considered that a short description of the general plan of the works is desirable.

The water is taken at the "receiving crib," which is located on the east bank of the Kansas River, some two miles above its junction with the Missouri River. From the crib a syphon pipe carries the water to the pumping station, located 1,300 ft. east of the bank of the river.

The syphon pipe is laid with a gradual rise from the river to the building, * * * where it enters the well 16 ft. above low-water mark, an air-pump being placed at this point to maintain the vacuum in pipe.

The first pumping of the water is done by sets of low-service pumps, which lift the water from pump well into a reservoir, located on the bottom land south of the engine house. This reservoir is so constructed that the water delivered into it has to travel twice the length of the reservoir before it can be drawn into the high-service pumps, giving a slow current to the water, and allowing precipitation of most of the materials held in suspension.

From the lower reservoir the water is carried to the high-pressure pumps through two lines of pipe 20 in. in diameter, one supplying the west set of pumps, and the other the east set. From the line running to the west set of pumps there are two 8-in. branches for supplying water to the old set of small pumps.

During the last year a new pumping machine has been added (in this report designated as the "east engine"). The capacity of the new pumps is somewhat greater than the old set, and the proportions of the steam working parts of the new machine are such that fire pressure can be had in the distribution without using water from the upper reservoir for back pressure. A further increase in pumping is now being secured by adding two new low-pressure service pumps, and by rebuilding the old set of high-pressure pumps. A new pump well is also under construction.

The engineer in charge states that this work will all be completed and ready for service within sixty days.

Outside the engine-house all the pumping mains unite in two 20-in. lines, one of which runs to the upper reservoir, having a 15-in. branch at Liberty street for "the supply of the bottom;" the other 20-in. line is used for the supply of upper town. The 15-in. branch at Liberty street is connected with both 20-in. lines, so that, by the opening of a valve on the connecting pipe and the closing of a valve on the branch, the pressure in "upper town" pumping main can be given to the distribution in "bottom" if so desired.

By an arrangement of pipes and valves in the basement of the engine house any of the pumps can take back pressure from the upper reservoir and repump the water at a greater pressure. It appears that this arrangement of taking water from the upper reservoir and repumping it was made to enable the "west engine" to give a fire pressure to the high parts of the city. The proportions of this machine are such as to require this back pressure on the pumps to secure the required pressure in the mains, except at a too great expenditure of steam.

The upper reservoir is built on the bluff northeast of the pumping station and about 2,500 ft. distant therefrom. The high-water line (2 ft. below top of embankment) is 232 ft. above directrix, and when the water is at this height the reservoir contains a little less than eight millions U. S. gallons.

The water pumped into this reservoir is used either to help the engines get up a fire pressure in the pipes or to supply the wants of "lower town" by gravity.

The original system of distribution seems to have been well devised and the sizes of the pipes, with one or two exceptions, fairly large; but in the additions made the pipes have been too small in diameter and altogether too many dead ends allowed.

In answer to subdivision *a* of question No. 3 we state: Hitherto, in the ordinary operation of the works the water supply for West Kansas City has been pumped into the upper reservoir and thence distributed to consumers by gravity, while the water supplied to "upper town" has been pumped into the distributing pipes directly from the lower basin.

Latterly, since the large fire on Union avenue, the water supply of the entire city has been pumped directly from the lower basin into the distribution pipes without going to the upper reservoir. This mode of supply necessitates that the distribution systems be worked together. In either case the water is not distributed in the manner required by Sec. 17 of the contract, yet this failure to comply with this provision of the contract cannot be considered a matter of any great importance.

(*b*) *Question.*—Are the pipes laid of sufficient size and so connected that at all points in the city the works can on actual trial throw streams of water as provided by Sec. 8 of said ordinance?

(*c*) *Question.*—Can the works by actual trial throw water as provided in said Sec. 8 at the same time "in the bottom" and on high ground, say at Coates' House, or at intersection of Ninth street and Forest avenue, throwing on half the streams in "the bottom" and the other half on high ground, and continue doing so for two hours or longer?

Answer.—Subdivisions *b* and *c* relate to the same subject, viz.: the ability of the works to comply with the requirements of Sec. 8 of the contract.

In our judgment the pressure required in the water mains to throw streams under the conditions mentioned in Sec. 8 of Ordinance 10,524 (water-works contract) would be so great that an actual attempt to perform the test called for would involve altogether too much risk to the water supply.

In our interviews with the officers of the water-works companies, however, they professed their ability to comply with the conditions of the section and their willingness to make the trial, and thus the test was attempted.

The point selected for the trial was doubtless the one most difficult of its accomplishment, being on the high elevation at High and Forest avenue.

Of the test called for by Sec. 8, the most difficult one is the "8 streams through 50 ft. of hose and 1¼-in. nozzles, 125 ft. high," and this was the test we designed to make, but neither the water company nor the fire department could furnish us with the required number of 1¼-in. nozzles, so that we were compelled to substitute streams through four 1½-in. nozzles (smooth), furnished by the fire department.

The streams thrown were from hydrants located as follows; in each case 50 ft. of hose was used:

No. 1 hydrant, corner	10th	and	Forest	avenue.		
No. 2	"	"	9th	"	Tracy	"
No. 3	"	"	9th	"	Troost	"
No. 4	"	"	8th	"	Forest	"

The elevation above the nozzle, attained by each of these streams, was measured by Wm. B. Knight, Civil Engineer, as follows:

Stream No. 1,	59 9/10 ft.,	elevation of ground	230 ft.
" No. 2,	48 ft.,	" "	220 ft.
" No. 3,	68 8/10 ft.,	" "	243 ft.
" No. 4,	50 6/10 ft.,	" "	233 ft.

After this experiment was concluded lines of hose were laid from each of the above located hydrants and the pipemen stationed at the intersection of 9th and Forest avenues, viz.:

From hydrant No. 1, length of hose, 500 ft.; from hydrant No. 2, length of hose, 350 ft.; from hydrant No. 3, length of hose, 400 ft.; from hydrant No. 4, length of hose, 400 ft.

These four streams were thrown through smooth nozzles of 1¼-in. diameter, and are the same nozzles ordinarily used by the fire department.

According to Mr. Knight's measurement these streams were thrown to an elevation of 73 8/10 ft. above the nozzles.

It was intended to continue the experiment by throwing streams at the same time from Ninth and Forest and from some hydrants located in the "bottom" (say Union and Mulberry streets), but just after the experiments at Ninth and Forest were completed, two pipes on Liberty street near Fourteenth street burst, and upon our arrival at the point selected for trial in lower town the water was shut off.

On April 15 test streams were thrown from hydrants on Union avenue, "lower town," and on Central avenue, between 10th and 12th streets, upper town.

At the first trial streams were thrown through 50 ft. of hose and 1½-in. nozzles. The heights attained by the streams were measured as follows:

1. Hydrant at Union and Santa Fe, 126 5/10 ft.
2. Two streams from hydrant at Union and Mulberry, 72 5/10 ft.
3. Hydrant at Union and Hickory, 91 ft.

The second trial was made by throwing the same number of streams in the lower town, and at the same time throwing four streams from hydrants located in Central avenue, between 10th and 12th streets.

The Central avenue streams were thrown through 50 ft. of hose and 1¼-in. nozzles, and attained a height as follows:

No. 1 hydrant at 12th and Central, 101 4/10 ft.

No. 2 hydrant at 11th and Central, 101⅞ ft. Two streams were thrown from this hydrant.

No. 3 hydrant at 10th and Central, 90 ft.

The elevation of ground is from 200 to 210 ft. Observations were taken of the streams thrown in the "bottom" while the streams were being thrown at 11th street and Central avenue, and they attained a height fully equal to that attained in the first trial.

The results of these experiments show conclusively that as at present arranged the works cannot comply with the tests prescribed in Sec. 8 of ordinance 10,524, that is, "in any part of the city," but that a supply of water under good pressure can be had for fire purposes even in elevated localities, *provided* the mains stand the extreme pressure required at the pumps to obtain it.

A tabulated statement is added to this report, showing the water pressure at the pumping engine at Plenkington & Armour's packing-house (West Kansas City), and on the gauge at the hydrants during the experiment.

It should be noticed in answer to latter part of subdivision *c*, that if notice and time be given the water department, so that the valves on the force mains and connections may be operated, then one set of pumps may be used for fire pressure into the pipes laid on the "bottoms," while another set of pumps gives fire pressure to upper town. In this case, however, the pressure in lower town distribution would be limited to the power of the west pumping machine (which is stated to be 130 lbs. per sq. in.), as when both pumping mains are in use, as they would have to be to fulfill above conditions, water could not be taken from upper reservoir to give back pressure.

Under the condition mentioned, the fire pressure streams could be kept up indefinitely unless some of the pipes burst or an accident happened to the pumps.

(*d*) *Question.*—Have the works two batteries of boilers, each sufficient to supply steam to throw water according to said Sec. 8, and as suggested above in questions *B* and *C*? If so, is the battery, in the usual operation of the works, under full head of steam, ready for immediate use in case of fire?

Answer.—There are at the pumping station what may be called two batteries of boilers; the first battery consists of three boilers, and the second of two, there being room enough in the building to add the third boiler when needed. The connections are arranged so that all the boilers can be used together or any one of them used in conjunction with any other one, each boiler having its steam-feed and blow-off connections separate and distinct from the others.

There is no doubt of the capacity of the boiler to insure sufficient steam to run all the engines up to any speed and pressure consistent with the safety of the water mains, presuming of course that the boilers are all kept in thorough repair.

The usual operation at the works requires the steam from three boilers; it will be seen, therefore, that the works have not "two batteries of boilers each sufficient to supply the steam to throw water according to said Sec. 8, etc.

The addition of another boiler would give the two batteries required. We are informed by the Chief Engineer of the works that three boilers are always under steam, ready for immediate use in case of fire. The pressure of steam carried is usually sixty pounds, which in case of fire can be promptly advanced to sixty-five or seventy pounds.

(*e*) *Question.*—Are all the pipes and connections of sufficient size, and so made at and with the lower reservoir as at all times to secure the best protection in case of fire?

Answer.—The connections from lower reservoir to the pumps consist of two lines of pipes each 20 in. in diameter. One line furnishes water to the west pumps and to the old set of small pumps (now being rebuilt) and the other line furnishes water to the pumps at the new (east) engine.

These pipes are of an ample capacity, and the connections as direct as the nature of the case will admit of.

(*f*) *Question.*—How many pumps and of what capacity, in gallons per minute, can be used in forcing water with the upper reservoir or into distributing main pipes in case of fire? Are the pumps so constructed that all can be used at once to force water for use in any part of the city to put out fire?

Answer.—When the improvements and additions now in progress are completed there will be 12 pumps that can be used for forcing water into the upper reservoir and into the distribution main pipes in case of fire.

We calculate the total capacity of these pumps to be 6,400 gallons per minute after deducting ten per cent. for loss of action.

The pump connections are so arranged and controlled by valves that all the pumps could be used to force water to any part of the city.

(*g*) *Question.*—Is the receiving crib properly constructed and of sufficient size so as to supply water continuously for a day or longer in case of fire, to comply with the provisions of said Sec. 8 for that time?

Answer.—At the present time the water in the river is so high that but little of the receiving crib can be seen.

We are informed by the engineer of the water company that the upper parts of the crib have been rebuilt within the last two years. Also that a brush mattrass has been laid on the river bottom above, in front of and below the crib, to prevent the work from failing from underwash. The mattrass is covered with rip-rap, and certain places where the river bottom had washed out in front of the crib have been filled with broken stone. The size of crib is ample for the quantity of water now required.

(*h*) *Question.*—Is the pipe from the river of sufficient size and so laid as to insure at all times an adequate supply of water in case of continuous fires both in bottom and on high ground?

Answer.—The syphon pipe used to convey the water from the "receiving crib" to the pump well is 24 in. in diameter and 1,350 ft. long.

The river end of this pipe is laid about 2 ft. below low water and the pump well end 8 ft. below low water.

If we assume a velocity of 4 ft. per second in this pipe the loss of head by friction will be about 5 ft. This would leave the pump well end of pipe covered 3 ft. at lowest water. The syphon could be worked under these conditions and would have a capacity sufficient for use in case of fires as supposed.

(*i*) *Question.*—Are the receiving wells and pumps of proper capacity to furnish at all times an adequate supply of water in case of extended fires, lasting a day or more?

Answer.—The water is pumped from the receiving well into the lower reservoir by the low-service pumps. As fast as the water is pumped from the well it is replaced by water flowing through the syphon pipe from the river. Thus the capacity of the receiving well is not a matter of consequence so long as it is large enough to accomodate the low-service pumps.

The capacity of the present two low-service pumps is equal to about 3,500 gallons per minute. When the two low-service pumps now building are completed and in service they will add about 5,000 gallons per minute.

Although the works are somewhat limited as to capacity for pumping from receiving well into lower reservoir just at present, the capacity at this point will be ample as soon as the new pumps are finished.

(*j*) *Question.*—Are the pipes throughout so strong that when water is thrown as provided in said Sec. 8, at points where it is most difficult to throw it, all other pipes freely connected with the pipes when the test is made will stand the pressure without breaking or injury?

Answer.—Our experiments prove conclusively that any attempt to throw streams in the elevated parts of the city with sufficient force or pressure to make them ordinarily effective in a case of fire is attended with great risks to the water mains in the lower parts of the city, *provided* the upper and lower distribution be connected.

During the time the streams were thrown at Ninth street and Forest avenue on April 4 there was only ordinary fire pressure on the pipes, according to the statement of the chief engineer of the water-works company. Yet, shortly after the hydrants used in the experiment were closed, two of the pipes in the main leading to "lower town" burst, the breaks being so serious that this portion of the city was without water for nearly twenty-four hours.

In our judgment, many of the pipes would not withstand the pressure required to comply with the conditions of Sec. 8 of contract.

(*k*) *Question.*—Is the upper reservoir of sufficient capacity and strength, and so connected with the system of pipes in "the bottom" and elsewhere as to be at all times ready for use in case of fire?

Answer.—The capacity of upper reservoir (with flow-line 2 ft. below top of bank) is somewhat less than 8,000,000 of U. S. gallons, which, at present rate of consumption, is equal to about three days' supply.

The embankments of the upper reservoir are built with very much less margin of strength than is allowed in similar structures, and it is our opinion that they are too slight to be considered reliable and safe if the water line be kept at proper elevation.

The reservoir may be connected with either system of distribution by a proper adjustment of the valves located on the "terrace" and on Liberty street, but connection with the upper town distribution would afford only limited fire protection.

(*l*) *Question.*—Use all the pumps to their full capacity and fire pressure in the pipes of say 160 pounds to the square inch, at the hydrants, and throw streams of water continuously, as provided by said Sec. 8; that is, twelve streams through 50 ft. of hose and a 1-in. nozzle and 100 ft. high, or eight streams through same hose and 1¼-in. nozzle and 125 ft. high, or four streams through same hose and 1⅝-in. nozzle, 150 ft. high, how long will it take to empty the upper reservoir, if filled at commencement of experiment, to ordinary height?

Answer.—The full capacity of the pumps is given in answer to subdivision *f* as being 6,400 gallons per minute. The quantity of water required to throw the 8 1¼-in. streams would be about 3,000 gallons per minute (this is a greater quantity than is needed for either of the other two tests), so the 3,000 gallons must be added to the maximum daily consumption, whice we will call 2,500 gallons per minute. Under these conditions the upper reservoir would supply water for back-pressure about 24 hours.

(*m*) *Question.*—As at present arranged, can the works at the same time, with the same force at water-works building operating in the pipes in the "bottom" and in balance of the city, throw streams as provided by said Sec. 8, at the four highest points in the city, without breaking or injuring pipes anywhere?

Answer.—In our opinion, any attempt to throw the streams required by the conditions of Sec. 8, of contract, at a time when the distribution system of upper and lower town are freely connected, would be attended with so much danger to the water supply of the city by the bursting of mains that it ought not to be seriously entertained.

(*n*) *Question.*—Are the district systems of pipes so arranged that in case of accident, repair or making new connections as few consumers as possible will be cut off or deprived of water?

Answer.—To insure that short lengths of distribution pipe, or as few consumers as possible be cut off or deprived of water in case of accident to the mains, would require that a large number of stop-valves be used. In our judgment the system is decidedly deficient in not having a sufficient number of stop-valves.

(*o*) *Question.*—Are the hydrants first-class in all respects? If not, what hydrants would be first-class in all respects? What changes, if any, would be made in hydrants?

Answer.—The stand-pipe of the hydrant is defective in having sudden changes in sectional area; also, the connection from the hydrant to the main is too small.

We consider that the stand-pipe of a first-class hydrant should have a free and clear water-way through it equal to the area of a circle 5 in. in diameter, and that it should be connected with the street main by a branch pipe not less than 6 in. in diameter.

We would recommend that in those portions of the city where four or more story buildings are erected, hydrants of larger capacity, such as we have described above, should be substituted, and that in all future extensions only hydrants of this class be used.

(*p*) *Question.*—Can water be thrown by the works in actual trial from both openings of a hydrant at once as mentioned in said Sec. 8, as high as therein stated? If not, how much will they fail of doing so?

Answer.—Our opinion in regard to throwing the best streams called for by Sec. 8 of contract has been given in answer to former questions.

The throwing of two streams from one hydrant would lessen the height of the streams as compared with one stream from the same hydrant, but to what extent depends on circumstances attending each case.

In the test made on Union avenue, April 15, the vertical height of the two streams from one hydrant, as compared with one stream from the next hydrant on the same main, fell short of the height of the single stream 25 per cent. In this case 1⅝-in nozzles were used. In the test made same day in Central avenue with 1⅛-in. nozzles the difference was less than 10 per cent.

In answering this question generally, as applied to this city, the length of the small or 4-in. pipes connecting the hydrant with mains forms an important element.

This difference in height of streams would be reduced to a minimum by the use of hydrants with large sectional area and 6-in. connections with street mains, such as we have designated as first-class hydrants in another part of this report.

(q) *Question.*—Should any alterations be made in the works so as to place the valves necessary to be opened or shut off for using fire pressure directly from the water-works building into the pipes in the "bottom" in or near to that building?

Answer.—In our judgment, the valves necessary to be operated to insure the pressure in the distribution pipes in "the bottom" should certainly be controlled and worked from the engine building.

8. *Question.*—What is the effect of "dead ends" to distributing main pipe in the throwing of water, according to Sec. 8, and what is the best way of overcoming that effect?

Answer.—The height of a stream thrown from a fire hydrant located on a "dead end" would be somewhat less than that of a stream thrown from a hydrant on a pipe that was connected, for the reason that on a "dead end" the water can flow to the opening from one direction only.

The best way of overcoming the effect of "dead ends" is by providing a connection with other distribution pipe. Where it is impracticable to make such connection the pipe should be of larger diameter than otherwise required.

9. *Question.*—What is the best kind of hose and the best kind of nozzle to use in making tests as provided for by said Sec. 8, and for ordinary use in putting out fires?

Answer.—The pressure at the hydrants being the same, rubber hose and smooth nozzles would give the most water and the best results.

10. *Question.*—Make practical suggestions, if any are deemed necessary, for alteration in any part of the water-works to carry out the spirit of the contract between the water-works company and the city, and insure the best fire protection for all parts of the city? Are there any particular dangers that either party should guard against, and if so, how?

Answer.—We recommend that steps be taken immediately, on the part of both city and water-works company to make extensions and improvements suggested in this report with a view of increasing the efficiency of the water-works and otherwise protecting the city against the dangers of fire.

The recommendations are as follows:

Laying a 20-in. main along the foot of the bluff as indicated in answer to question No. 2. Also the following pipe mains: 20-in. main on Santa Fe street from Twelfth to Ninth streets, 15-in. main starting from Eighteenth street and Liberty running west on Eighteenth street to Wyoming, north on Wyoming to Seventeenth, west on Seventeenth to Genesee and on Genesee to Ninth street.

Twelve-inch main on Thirteenth from Main to Holmes, on Holmes from Thirteenth to Twelfth, and on Twelfth from Holmes to Forest.

All the above mains to be connected with the present distribution pipe wherever it crosses the same.

Also the laying of various pieces of distribution pipe to connect "dead ends."

No distribution pipe to be laid hereafter less than 6 in. in diameter.

All new fire hydrants to be as stated in answer to question 3, subdivision o.

In those portions of the city where the buildings are high, and the property to be protected is of great value, the fire hydrants should be placed at distances of not more than 200 ft. apart, so that in case of fire the length of hose lines would be as short as possible.

In all future extensions shut-off valves should be placed so as to average not less than 6 valves to the mile of pipe.

Every valve and fire-plug should be inspected and operated by the water department at least once in three months, and the result of said inspection reported to the fire department. During severely cold weather the inspection of fire-plugs be made every day, and any plugs used for the extinguishment of fire should always be examined immediately (the following day) after such use.

The capacity of the lower reservoir should be increased in order to give the water sufficient time to deposit the material held in suspension.

This, we understand, is an improvement the company now have in progress.

The upper reservoir, if the terms of Sec. 17 of the contract are to be complied with, would have to be increased to about three times its present capacity, but in our opinion no special benefit would be derived from such an enlargement, but we do recommend, in lieu of such an extension, the company be required to build a separate and independent reservoir of about ten millions capacity, to insure safety in case of failure of the other reservoir.

An additional boiler should be set at the pumping works as indicated in answer to subdivision *d*, question 3, and in the course of the next 3 years another pumping engine will be needed.

Some additional steam fire engines should be procured, particularly for use in the "bottom," and all should be fully equipped for active service upon the alarm of fire.

The suction hose of the steam fire engines should at once be fitted to take water directly from the fire hydrants.

The above are the main features of the immediate future requirements of the works.

Although the water-works are owned by a private company, yet as now situated the prosperity of the city is so greatly dependent upon their efficiency that it would seem that all the legislation on the part of the city government required in the opening and grading of streets in certain localities, in order to allow the water company to put in their main pipes ought to be had. This is a very important question and should receive the attention of the officers of the city and of the water-works company at once.

11. *Question.*—During the late fire in West Kansas streams could not be thrown beyond the third-story windows, and during part of the time no water at all was furnished?

If you can give any reason therefor please do so, and is such an accident liable to occur again?

Answer.—We have attempted to attain all important facts in connection with the late fire on Union avenue, relating to the failure of the water supply, and for that purpose have taken the statements of officers and employés of both fire and water departments. The facts seem to be: The fire broke out about 3 a. m. on the 10th of March. A few minutes afterwards the fire department had four streams on the buildings. The water pressure being too weak to do effective work with these streams, a telephone message was sent to the pumping station for more pressure.

At about half past three a special messenger on horseback was sent to the pumping station with same request.

Between half-past three and four o'clock the flow of the water ceased entirely, and was stopped about half an hour.

About quarter past four o'clock the water again commenced to flow, with a pressure about the same as before the stoppage.

At a quarter past four the elevation of water in reservoir was very nearly at high-water line, and at half past five (an hour and a quarter) the water in the reservoir had fallen 4 ft.

Taking into account all the statements, viz.: those of Mr. Hale, of the fire department as to what occurred at the fire, Mr. Pearsons, as to what was done at the engine house and valves, and the reservoir keeper as to elevation of the water in the reservoir, we judge the following to be the probable conditions at the time of the fire:

The first streams were thrown with a head due to the elevation of water in upper reservoir.

That in operating the valves to give pressure from the pumps a mistake was made by moving the valves, so as to shut the water off from the "bottom" entirely.

That as soon as this mistake was discovered the valves were replaced same as at first; that is, so as to give water to lower town from the reservoir. The evidence seems positive that during the hour and a quarter between quarter-past four and half-past five on the morning of the fire some 4 ft. of water was taken out of the upper reservoir.

If this water was not used directly on the fire, then it must have been taken for back pressure on the pumps; and as the streams at the fire were not improved over what they had been at the commencement, it would simply prove, if we assume that the water was repumped, that the pumping machinery was in such condition as not to be capable of giving an efficient fire pressure.

Unless the failure to get water of sufficient pressure at this fire was due to wrongly operating the valves (a recurrence of which would be a matter that could, to a great extent, be provided against), then we see no reason why the same condition may not occur again.

12. *Question.*—Will the present system of work, with such extensions as the company may make, be sufficient when the city attains a population of 100,000, and be able to furnish adequate fire protection at all points, or will such system suit a much larger city?

Answer.—It is our opinion that it will not.

The extensions and improvements that we have suggested will greatly increase the value of the water-works as a fire protection.

But we think it unsafe to depend entirely upon the water-works, and have recommended increasing the number of steam fire engines.

As the city increases in size and becomes more compactly built it can easily be divided into more than the two districts (upper and lower town) now existing, and fire protection can be afforded.

It may then be found too expensive to extend the present system of direct pressure to all parts of the city. Some portions could be supplied by a reservoir properly located, while it might be well to use the present system of direct pressure in other districts.

The principal cost of the improvements we have recommended as necessary now will be in the pipes, valves and hydrants, and a new reservoir, all of which would be valuable and necessary in any system. The ultimate changing of this system of works to that generally approved and adopted in all large cities would result in a saving to the company as well as the city.

There would be the substitution of larger and more economical working engines, the maintenance of a more uniform head of water and a lessening of the excessive shocks and breaking of mains.

In all systems of direct pumping into the mains at a pressure sufficient to give effective fire streams, the bursting of pipe is the danger that is always imminent, and such an accident destroys the use of the works when most needed.

13. *Question.*—Does the ordinary use of water from the mains by private consumers detract from the fire pressure, and will an increase of consumers prevent throwing of streams as provided in Sec. 8.

Answer.—As the ordinary consumption of water from the mains increases, it will detract more and more from the effectiveness of the fire pressure. If, however, the pumping capacity be kept up fully to the maximum hourly consumption, plus the quantity that may be required for fires, the consumption through service pipes would not affect the fire pressure seriously, except in case of a large draft happening in one locality.

14. *Question.*—The hydrant elevators in use have openings from 2¼ to 3½ in. Is it practical to reduce these openings by using proper air chambers so as to lessen the momentary flow, reduce shocks in the pipes and lessen liability to large losses from breakage in case of fire?

Answer.—Either an air chamber or an elevated tank, used in conjunction with the hydraulic elevators, will allow of the connections being reduced in size and lessen the shocks to the mains, etc.

15. *Question.*—What is the proper horizontal equivalency for test streams to be thrown as named in the ordinance?

Answer.—The ratio between the vertical height of a stream and the greatest horizontal distance that the same stream may be thrown varies with the diameter of and the pressure at the nozzle.

For such streams as required by Sec. 8, of the contract, this ratio would be as 3 is to 4, as follows:

Diameter of nozzle.	Vertical height.	Horizontal distance.
1½ in.	150 ft.	200 ft.
1¼ in.	125 ft.	167 ft.
1 in.	100 ft.	133 ft.

16. *Question.*—Is the reservoir pressure (190 ft. elevation) sufficient to throw streams over a five-story building in W. Kansas City.

Answer.—The top water line of the upper reservoir is 232 ft. above directrix. The grade of the streets in "the bottom" may be taken at 25 ft. above directrix, leaving 207 ft. of head.

A stream to be thrown over a five-story building should have a vertical height of at least 85 ft. If the stream be thrown through a nozzle of 1¼-in. diameter and 350 ft. of hose, the head required at the hydrant to give the stream 85 ft. of elevation would be fully 210 ft.

Thus, even if we leave out of consideration the loss of head in the mains by friction, due to furnishing water for the stream and the ordinary consumption, the elevation of the water in the reservoir is not sufficient to throw the stream over a five-story building (under conditions above named) by gravity.

We are under obligations to the city engineer, John Donnelly, C. E., the chief engineer of the water-works, G. W. Pearsons, C. E., and also the superintendent of the water-works, B. F. Jones, Esq., for valuable assistance cheerfully rendered, and for furnishing all needed information, and giving us access to the maps and plans of the city and the water-works.

We desire also to thank Col. Forster, chief of the fire department, and his officers and men, for

furnishing the hose and all needed appliances and making the tests on April 4 and 15.

Respectfully submitted,

Signed. { THOS. J. WHITMAN, C.E.
MOSES LANE, C. E.
HENRY FLAD, C. E.

A GREAT LONGITUDINAL ENTERPRISE.

Almost everyone who is familiar with the railroad system of this hemisphere is aware of the fact that there is no railroad or telegraph line connecting Behring Strait with Cape Horn; comparatively few persons, however, know that such a highway has for some years been under consideration, and that if it has not yet been actually built, it is not for want of generous and public-spirited promoters. It is now two years since Mr. Hilton Rowan Helper, of St. Louis, addressed to the Hon. Thomas Allen, president of the Iron Mountain and Southern Railway, Mr. Carlos S. Greeley, receiver of the Kansas Pacific Railway, and Dr. William T. Harris, Superintendent of Public Instruction, a communication on the subject of "a longitudinal midland double-track steel railway from a point high north in North America running more or less southwardly through Mexico and Central America, to a point far south in South America, looking ultimately to such necessary and gradual extensions at either end, from time to time, as will eventually place Behring Strait and Cape Horn, and all the intermediate localities in uninterrupted and continuous overland communication by steam and by telegraph." Stating that he had long regarded this as a "perfectly practical enterprise," he gave a most convincing proof of his sincerity by inclosing to his correspondents a check for five thousand dollars, to be expended by them as a Committee of Award "in obtaining five of the most convincing and meritorious essays which may be offered," "three in prose and two in poetry, in truthful and vigorous and effective advocacy of the undertaking."

If the scheme of the Three Americas Intercontinental Railway had proceed no farther than this we should have thought it open to a good deal of criticism; it would have been merely the idea—a grand and original idea no doubt, but still merely the idea—of a single advance thinker, who ran great risk of being thought to have a mind too longitudinal and intercontinental for his age. But it by no means stopped here, for the gentlemen selected by Mr. Helper as his committee all accepted the commission, and wrote a letter to the promoter of the Three Americas Railway in which they gave expression to their "ardent hopes, braced by a high degree of confidence," that the road might be completed by the 14th of October, 1892, the four hundredth anniversary of the discovery of America. Dr. Harris did indeed subsequently resign from the committee, but this was merely on account of enforced absence in Europe, and Professor Horace H. Morgan, principal of the St. Louis High-School, immediately accepted a position on the committee as his successor.

The committee now proceeded to engage in what they refer to as "the somewhat fatiguing and responsible but peculiar and interesting labors" of their task. They received in all forty-nine essays and poems from forty-seven contestants, and awarded five prizes—three for prose and two for poetry; and in communicating the result to Mr. Helper say explicitly that, as the result of some six months' consideration of the subject, "we incline to the opinion that there are but few, if any, clear-headed thinkers in this or any other country who will arise from a careful perusal of the five successful papers which you have thus elicited without giving a hearty assent to the general correctness of your own views in relation to this stupendous enterprise."

Mr. Helper has now collected all these essays, and the correspondence and other papers relating to the subject into a volume, under the attractive title of "The Three Americas Railway: An international and intercontinental enterprise, outlined in numerous formal disquisitions and five elaborate essays; all strongly advocating free and fast and full and friendly intercommunication between the sixteeen adjunctive and concordant republics of the New World;" and few, if any, clear-headed thinkers will question the propriety of his doing so. Of course, Professor Morgan, being chiefly devoted to educational work, might be suspected of approaching a project of this sort in an unpractical way, of being carried away by a sudden enthusiasm for longitudinal enterprises—though even this does not seem probable of a man who has recently received, as we are informed by Mr. Helper himself, a notable literary prize in "Brain-abounding Boston." But the other two members of the committee are practical men; one is president of an important and somewhat longitudinal railroad, the other is a railroad receiver, and all clear-headed thinkers who know anything about receivers know that they are seldom or never doctrinaries or idealists. Why these two gentlemen should encourage Mr. Helper to believe that his railroad from Behring Strait to Cape Horn can be built, unless it actually can be built, we cannot conceive.

As to the manner of executing the work, it is as yet evidently too early to go into details. "Shall the work be done," the projector asks, "by a nationally and internationally incorporated private company, or by the concerted and concentrated action of the governments of an unbroken series of sixteen of the most stately republics that the wisdom and virtues of the noblest specimens of mankind have ever yet framed upon the earth?" So we might ask, shall the capital stock be all paid in, or shall the road, like so many latitudinal highways, be built on bonds with the aid of a construction company? These, are, after all, matters of detail. The important thing now is to arouse public sentiment in its favor by convincing clear-headed thinkers that it can be done, and this is the object of Mr. Helper's book.

Among other interesting features of the enterprise is the determination of the promoter that this shall be a republican as well as a longitudinal highway. He says that he has "not forgotten" Brazil, and such would seem to be the case from his casual reference to that Empire as "bigoted and benighted Brazil," "priest-ridden and prelate-poluted Brazil," "slavery-sustaining and progress-retarding Brazil," "negro-cursed and hybrid-blasted Brazil," "besotted and begrimed Brazil." The toleration by Brazil of monarchy, slavery and Catholicism combined early led Mr. Helper to form an unfavorable opinion of the Empire, but he says that he was not absolutely decided about what stand he should take with regard to it until the claim of Mrs. Helen M. Fiedler, "a worthy and widowed citizen of the United States," against the Brazilian Government, intrusted to him for collection, was rejected. As we understand it, if the Fiedler claim—it was only $31,800—had been paid, it was Mr. Helper's intention to have a lateral road constructed to Rio Janeiro; and he prepared a letter for the perusal of Dom Pedro, very frankly stating the connection between the Three Americas Railway and the claim; and calling his Majesty's attention to the fact that, if the claim was paid, he would probably, inside of fourteen years, be able to go by special train from Rio to New York in a week. He pointed out also the undeniable fact that by a land-route between these points "a long voyage, sea-sickness, storms at sea, and all the other discomforts and perils incident to ocean travel" would be avoided. The letter was never sent, however, the Fiedler claim was never paid, and the besotted, priest-ridden old bigot will have to go to New York just as he used to do.

It would be pleasant to let the imagination dwell upon the future of this great international highway, but we have little space for further quotations. A perusal of Mr. Carpenter's prize poem will convince any impartial person that the subject is one quite as well fitted for verse as for prose. Anticipating the objection that the scheme will be called Utopian, the poet meets it in this way:

"Utopia's great plan
Is more than realized in our completeness.
For through Utopia no railway ran;
No steamship sailed its seas in strength and fleetness;
No telegraph embraced it in its span."

He calls attention to the fact that railroads running east and west have "found a limit by the wide Pacific," while longitudinally the whole hemisphere is open, and in three beautiful lines tersely states the great economical truth which anybody inclined to "bear" the future stock of the Three Americas Railway will do well to notice, that

"The railroad paves the way
Of its advance, and smooths the ground before it
With profits that are earned from day to day."

It is, in short, a grand scheme, and ought to interest every native of America from Patagonia to "brain-abounding" Boston itself. The Brazilians will be sorry yet for the part they have played in the matter.—*The Nation, July 21.*

NOTES.

AMERICAN INVENTIONS.

The sixteen American inventions of world-wide adoption are the cotton gin, the planing machine, the telegraph, the grass mower and reaper, the rotary printing press, steam navigation, the hot-air engine, the sewing machine, the India rubber industry, the machine manufacture of horse shoes, the sand blast for carving, the gauge lathe, the grain elevator, artificial ice-making on a large scale, the electric magnet and its practical application, the telephone.

WHAT IS NICKEL?

Since the convenient five-cent coin, which, in common talk is called a nickel, has come into common circulation, the question above is asked either mentally or orally hundreds of times every day, and but few get an intelligent answer. In China and India a white copper called pack tong has long been known, and has been extensively used both there and in Europe for counterfeiting silver coin. About the year 1700 a peculiar ore was discovered in the copper mines of Saxony, which had the appearance of being very rich, but in smelting it yielded the copper and the miners called it kupfer nickel, or false copper. In 1754 Constandt announced the discovery of a new metal in kupfer nickel. It was in combination with arsenic, from which he could relieve it only in parts. The alloy of nickel and arsenic which he obtained was white, brittle and very hard, and had a melting point nearly as high as cast iron. It was not until 1823 that pure nickel was obtained by analysis of German silver, which has for a number of years been produced at Spuhl, in Saxony. Its composition was ascertained to be copper ten parts, zinc five, and nickel four. If more nickel be used the alloy is as white as silver, and susceptible of a very high polish, but becomes too brittle and hard to be hammered or rolled, and can be worked only by casting. Pure nickel is a white metal which tarnishes readily in the air. Unlike silver, it is not acted upon by the vapor of sulphur, and even the strong mineral acids attract it but slightly. Nickel has the hardness of iron, and like it has strong magnetic properties, but cannot be welded, and is soldered with difficulty. Pure nickel has heretofore been used chiefly for plating, for which purpose its hardness and power to resist atmospheric influences admirably adapt it. Within the last year the French have succeeded in rolling the metal into plates, from which spoons and other table furniture may be pressed. Nickel bronze, which consists of equal parts of copper and nickel, with a little tin, may be cast into very delicate forms, and is susceptible of a very high polish. Mines of nickel are worked at Chatham, Conn., and Lancaster, Pa., and it is said to be found at Mine La Mott, Mo., and at several points in Colorado and New Mexico, where but little attention is paid to it. It is extensively mined in Saxony and Sweden, but the late discovery of a new ore (a silicate of nickel) in New Caledonia will probably suspend the use of the arsenical ores, and yet bring nickel into common use. Switzerland, in the year 1852, made a coin of German silver, which is identical in composition with our nickel coin. The United States made nickel cents in 1856, and eight years later coined the five-cent pieces. Belgium adopted nickel coinage in 1860, and Germany in 1873. England has lately coined pennies for Jamaica, but at home she and France adhere to the clumsy copper small change.—*Ex.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Fort Dodge, Iowa, is to have an $18,000 set of waterworks.

Kenton, Ohio, has contracted for building waterworks after the Holly system.

Work is progressing rapidly on the Parkdale, Ontario, water-works. The mains are being laid.

The water-works in the village of New Brighton, S. I., were put in operation on July 28.

COLUMBUS, July 31.—The Water-works trustees have a contract with the Columbus Pipe Foundry for a large supply of water pipe. A number of these were weighed on Saturday, showing that they fell short in each instance from 20 to 100 pounds to a section, making a large deficiency in the aggregate for which the city has has been paying.

While borings were being made for an artesian well at the Manitoba provincial penitentiary recently, a good red clay was struck at a depth of 79 feet. It was brought to the surface in a liquid condition, and Warden Benson had it dried and afterwards powdered and mixed with oil, producing an excellent fire-proof paint, which is now being used in painting the roofs of the guards' houses.

Recently the McKeesport Water Committee closed a contract with R. D. Wood & Co., of Philadelphia, to construct their water-works at a cost of $83,000. The

contract for laying the pipes was sublet to Eichbach & Foster, of Philadelphia, and the boilers to Walter Jarbal of this city. In addition to the work specified by the committee, Wood & Co. offer to build the stone wall at the pump house, and place an iron fence around the reservoir.

A deputation from Woodbridge, consisting of Mr. Clark Wallace M. P., Mr. J. McIntyre and Mr. Abell, were in town on Tuesday making inquiries as to the cost of water-works in the village, the construction of which is under consideration. It is the intention of the authorities to lay a main water pipe along the three principal streets of the village, and to place hydrants at short distances from each other along these streets. Mr. Abell, who takes a deep interest in the project, has consented to supply the necessary water-power from his turbine water wheel. A volunteer fire brigade will then be organized, in order that a recurrence of last week's experience may not be possible. Several of the fire stations were visited by the deputation, and some useful hints as to the successful working of a brigade collected.—*Toronto (Canada) Globe.*

CINCINNATI, Aug. 1.—The Cincinnati Gas-Light and Coke Company have purchased what is known as Sportaman's Hall, in Columbia, with enough of the grounds surrounding to give them a lot with a 400-foot front and 600 feet in depth. It is the purpose of the company to put up extensive works on this site at a cost of about $400,000. Plans are already being drawn, and work will be begun at an early date. The purpose of the company in building works at that point is partly to afford a nearer source of gas supply for the eastern part of the city, and partly to duplicate their old works, so that in case of an explosion or fire the city can be supplied from the works which have suffered no accident. The company's stock is selling at 170, and it has a large surplus on hand. Knowing ones state that the new works can be put up without any assessment being made upon the stockholders. The site chosen is on the bank of the river and admirably adapted for the company's purpose.

The Newark Aqueduct Board recently made an inspection of the waters of the Passaic River, from which the Newark and Jersey City people draw their supply. The Jersey City Board of Works had been invited to accompany the excursionists, but not a member of the board was present. The purpose of the inspection was to ascertain the source and extent of the water's pollution. The water is certainly unfit to drink, and its odor is actually offensive as it pours from the faucets in the houses of consumers. The trial of the Kingslands showed that one of the sources of pollution is the refuse and dyestuff poured into it from the mills that line the river, and the sewage and filth from them and from the cities fronting on the stream. The mill-owners still persist in emptying their refuse into the river, and the members of the Newark board are exerting themselves to the extent of their powers to put an end to the practice. The board notified those of the mill-owners whom they saw that unless they built sinks for the collection of their sewage, and to prevent it mingling with the river water, they would be prosecuted. It is intimated that the Newark board will go before the next grand jury and seek the indictment of others of the mill-owners than those who have already been prosecuted. A new remedy suggested is to construct a sewerage system skirting Paterson and Passaic that will empty the sewage of the two cities below the Dundee Dam, and then to connect the water-works of Jersey City and Newark with the waters above the dam; but that plan will be an expensive one.

The private water-works scheme has been referred to the mayor, comptroller and commissioner of public works to draft an ordinance that will more nearly meet the popular approval than the one at first presented. These officials have talked of the matter, but have not yet come to any agreement. The mayor favors the private enterprise, because he says the works are needed at once and the city cannot build them. He thinks an ordinance can be framed which will require the company to pay all its profits in excess of 6 per cent. to the city to create a sinking fund, which the city may use to buy out the private corporation at the end of a given period. He thinks that the city's interest could be sufficiently guarded by a proper ordinance. Commissioner Waller continues to oppose the scheme. If the power be delegated by the ordinance as the mayor proposes, there would be nothing to prevent a corrupt council at any future time from relieving the company from the necessity of paying the city any profits, or of even selling out to the city. The business portion of the city is becoming to be substantially paved, and the commissioner is opposed to allowing a new corporation to come in and tear up the streets with a recklessness that a private corporation always shows. Moreover, he is still of the opinion that the city can build the works. If a franchise is to be let to a private corporation, he favors a contract instead of an ordinance. This would guard, in a measure, against changes by future councils.—*Chicago Evening Journal, July 29.*

RAILROADS.

The Union Pacific contemplates building a double track from Omaha to Valley Junction.

FORT WORTH, Tex., July 27.—The end of the track of the southern extension of the Missouri, Kansas & Texas is now twenty-eight miles south of Fort Worth.

The Maine Central Railroad Company are to survey a route between Dexter and Presque Isle, by way of Houlton.

The new extension of the Long Island Railroad from Patchogue to Eastport was opened to the public yesterday.

The Toledo, Ann Arbor & Grand Trunk Railroad was finished to South Lyon, Mich., yesterday. The event was celebrated by running an excursion train.

The extension of the Toledo, Delphos & Burlington Railroad will probably be completed by Thanksgiving. Two tunnels have been cut on the Ironton extension, so the Toledo, Delphos & Burlington will not probably be open to the Ohio before the first of the year.

The Denver *Tribune* of the 27th says: "The Denver & South Park road has at last bored through the Alpine Peak. The first streak of daylight shot through the great tunnel yesterday morning. The company claims that it will be in Gunnison City in six weeks."

The Meadville Railway was completed last week to the southern part of Meadville, Pa. This railroad is eighteen miles in length, connecting at Linesville with the Erie & Pittsburg Railway, and will be operated by the Pennsylvania Central.

ANN ARBOR, Mich., July 29.—The first train over the Toledo & Ann Arbor Grand Trunk Railroad ran to-day from South Lyon, to which point the road is just completed. To-night two hundred and fifty excursionists from South Lyon, with a band of music, visited this place.—*Cincinnati Commercial.*

The gauge of the Mississippi & Tennessee Railroad, running from Memphis, Tenn., to Grenada, Miss., 100 miles, was changed Friday from five feet to four feet eight and one-half inches. The work was successfully done in ten hours, with no interruption to south-bound trains and traffic of the road.

The East Texas Railroad Company filed at the State Department of Texas on Saturday an amended charter, changing the name of the company to that of the Sabine East Texas Midland Company, and providing for constructing a branch road from some point in Nacogdoches County to a point on the Sabine River opposite Logansport.

The work of putting down the third rail on the Denver & Rio Grande Railway, between Denver and Pueblo, is progressing rapidly, and over thirty miles are now completed. The whole will be laid in a few weeks, and thus facilitate through shipments between the East and Denver, as well as Pueblo, without the necessity of transfer.

ST. LOUIS, July 29.—The track of the extension of the Missouri Pacific Railroad southward through the central southwestern part of the State was completed yesterday to Carthage, in the great lead-producing region of Missouri, and was inspected by General Manager Talmage, who was there, accompanied by several other officers of the road.

The Dayton, Evansville & Southwestern Railway Company, and the Evansville, Dayton & Eastern have filed articles of consolidation in Indianapolis under the name of the Evansville, Dayton & Eastern Railroad Company. W. Edgar Bird heads the directors. The road is now being built between Evansville and Dayton, O.

The experiment of running a locomotive without brakes has just been successfully tried by the Delaware, Lackawanna & Western Railway Company. The locomotive is of ordinary pattern, but has an extra pipe leading from the boiler to the steam chest, by which power can be applied against the piston, checking the engine and enabling the engine to reverse without "hauling over."

The Evansville, Rockport & Eastern road has been sold to the Louisville, New Albany & St. Louis Company. It extends from Evansville, Ind., to Jasper, 55 miles, with a branch from Gentryville to Rockport. It is a consolidation of the Cincinnati, Rockport & Southwestern and the Lake Erie, Evansville & Southwestern, and was owned, we believe, by an organization known as the Evansville Local Trade Company.

Railway projects are so numerous in the great State of Texas, says the *Railway Review*, that it is well nigh impossible to keep the run of them. Besides the independent new lines, fifteen roads are building extensions. Six hundred and sixty-two and eight-tenths miles of road were built last year, and more than that have already been built this year. The narrow-gauge system of the State included 528.5 miles of road at the beginning of this year, and the amount of narrow-gauge track projected is enormous.

The prospects of the Montreal & Eastern Ontario Railway seem to be growing brighter. The railway will start from Smith's Falls, passing eastward through the northern parts of the counties of Dundas, Stormont and Glengarry, joining the Grand Trunk at or near Vaudreuil. Prominent men in the townships through which the line will pass are moving in the matter, and well-known capitalists are ready to undertake the work, provided that reasonable encouragement be granted. An engineer will pass over the proposed line next week.

A Lincoln (Neb.) dispatch says: "It is now definitely settled that the much-talked of Lincoln & Fremont Railroad will be pushed to completion as fast as men and money will do it. The subscription books have been opened less than a week and the capital stock, $1,000,000, has been subscribed. The managers of the new road are highly gratified as to the result of their labors and will lose no time in arranging the preliminaries of the work. Grading will be commenced at once and it is thought that before the snow flies next winter the road will be in active operation."

The Rochester Division of the New York, Lake Erie & Western Railway, 99 miles, connecting Rochester with the main line of the Erie road at Corning, Steuben County, was narrow-gauged Saturday. Preparations for the work have been going on for months, and the rolling-stock has been changed from time to time by the road without the employment of additional help. The old gauge was six feet wide, and the new standard gauge four feet eight and one-half inches. The work of narrowing was commenced at 4:30 o'clock in the morning, and the road was ready for a narrow-gauge train at 7:25 o'clock. Only 450 men were employed.

A dispatch from Yuma, Ariz., says: "The Southern Pacific Railroad Company has commenced a suit in the District Court here against the Texas & Pacific Railroad Company to restrain the defendant during the pending of the action from commencing or prosecuting any actions or proceedings against the plaintiff or its lessee to determine the title to the real property comprised within the lines of the right of way claimed by the plaintiff or the right to its use or occupation; that upon the final hearing of the action the adverse claims of the defendant may be determined, and that it may be adjuged that the plaintiff is the owner of the said real property; that the defendant's claims thereto are invalid, and that the defendant has no interest in or claim to the said property, and that the temporary restraining order be made perpetual."

CAIRO, Ill., July 29.—To-day the Chicago, St. Louis & New Orleans Railroad Company accomplished the tremendous task of changing the gauge on their line from New Orleans to Cairo. To complete the herculean task a force of over 3,000 men was distributed along the line. This is the greatest feat yet accomplished in gauge-changing, and to Colonel L. P. Brien, Assistant General Manager, is the success mainly due. It is estimated that the actual cost of the work is about $300,000. The width of the track on 571 miles of road was altered from 5 ft. to 4 ft. 8½ in., the standard gauge of the great trunks lines north of the Ohio River. The work began as soon as it was light enough to work, and was finished at 3 p. m. Engines were started in both directions from each of the three shops—at Jackson, Water Valley and McComb City—early in the morning to test the track, and followed the work as it progressed. On the main track the men were distributed in the proportion of two-and-a-half men to the mile, or 1,500 men, not including gangs at the various yards. Almost simultaneously sixty locomotives, 1,200 freight cars and all the passenger cars were narrowed in readiness for the change of track. The west rail was moved inwards 3⅛ inches. All the spikes on the inside of rails to be changed had already been drawn, except the spike in every fourth tie on straight lines and every third tie on curves. Spikes for the new gauge were already driven in every fourth tie and third. All necessary spikes were distributed on the ends of ties into which they were to be driven. Each section foreman was furnished with a narrow-gauge hand-car and a full set of tools. The implements were distributed among the men in each section thus, five men with claw hammers drew inside spikes, one man with spike maul drove down stubs, and four men threw in the rail; and there were five outside spikers, two inside spikers, two extra men and one man to push hand-car and carry water. The sections were clearly laid out in order, each having a road master. Not the least difficult part of the undertaking was the locating of the rolling stock so as not to interfere with the work. But all the directions were fully carried out.

NEW PROJECTS.

The Chicago, Milwaukee & St. Paul Railway Company has decided to construct car-shops in Milwaukee at an expense of $205,000. Two thousand men will be employed, the contract for a building-lot having been located in the Menominee Valley yesterday.

The Charlotte & Lake View Railroad Company was incorporated in Albany, with a capital of $200,000. The lines are to be wholly within Monroe County, N. Y. The Great Valley & Bradford Railroad Company was also incorporated. This road will be twelve miles in length, and will have a capital of $120,000. It will run from Great Valley, Cattaraugus County, direct to the Pennsylvania State line.

The articles of incorporation of the Denver, Rio Grande & Western Railway Company have just been filed in Salt Lake City, Utah. The capital stock is $37,480,000, General Palmer, President of the Denver & Rio Grande Railway, is the heaviest owner. The entire length of the main line and branches of the Denver & Rio Grande will be about 2,370 miles. It is proposed to push the construction with such energy as to finish the main line by the end of next month.

A project has been started to build a narrow-gauge railroad in Eastern New York, between Tarrytown and Portchester by way of White Plains, so as to form connections between the Hudson River Railroad at Tarrytown, the New York City & Northern Railroad near Hall's Corners, the Harlem Railroad at White Plains, and the New Haven Railroad; also with the prospective Housatonic & Northern and the New York & Connecticut Valley railroads.

The Morris, Rockford & Northwestern Railroad Company has filed articles of incorporation with the Illinois Secretary of State; capital stock, $100,000. The proposition is to construct a road from Bruceville, Grundy County, to the Chicago & Northwestern Railway, in the city of Rockford. The incorporators and first board of directors are Philip C. Hayes, Lafayette Beach, Nathaniel McBridge, Aaron G. Woodbury, Henry Burrell and John H. Sampson, all of Morris, Grundy County.